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A Monthly Review of Veterinary Science.

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LONDON:
BAILLIÈRE, TINDALL & COX,
8 Henrietta Street, Covent Garden, W.C. 2.

AGENTS { United States—ALEXANDER EGER, Chicago.
Australia—GORDON & GOTCH, Melbourne, Sidney, Wellington.
Canada—THE MACMILLAN CO., Toronto.

Entered as Second-Class Matter in the U.S. Post Office.

...se No. 585. Vol. 80, No. 3.

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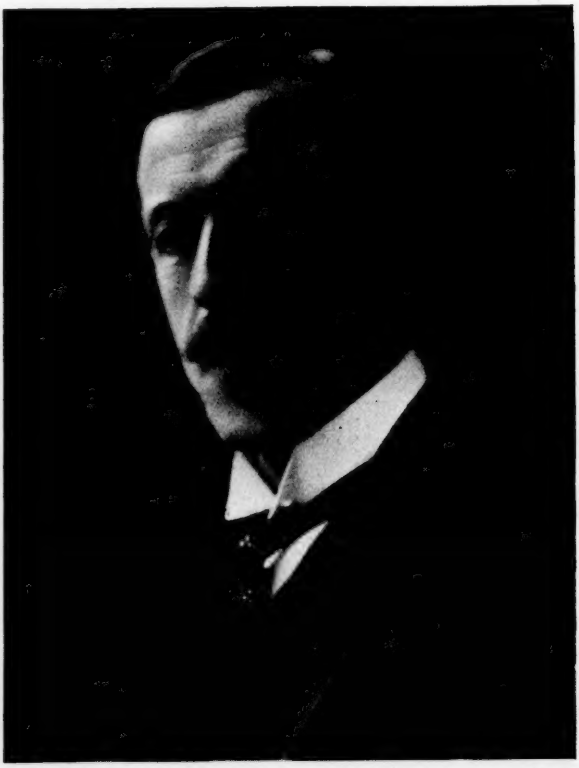

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SIR STEWART STOCKMAN, M.R.C.V.S.

President of the Royal College of Veterinary Surgeons.
Chief Veterinary Officer of the Ministry of Agriculture.

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MARCH, 1924.

Editorial

THE PRESENT OUTBREAK OF FOOT-AND-MOUTH DISEASE.

ACCORDING to the latest report of the Ministry of Agriculture, which has reached us as we go to press, there are distinct signs that the present outbreak is under control, and it is a matter for congratulation on the part of the agricultural community, the public, and the veterinary profession, that Sir Stewart Stockman and the veterinary advisors at the Ministry of Agriculture have stood firm in the principles which they originally adopted. Had they wavered, or been influenced by some of the absurd and hysterical outcries which appeared in the daily press, the results would have been appalling in their consequences. Not only would the cost to the taxpayer have become an annual one, but the effect on the dairying and cattle raising industry in this country would have been disastrous. Foreign buyers have come to this country in the past with the full knowledge that not only were they buying the best of pedigree stock, but they were purchasing it from a country which was free from a number of the contagious plagues which caused our Continental neighbours many millions of pounds. Insulated as we are by the sea, it has always been our proud boast that, when once we had stamped out any virulent contagious disease which had appeared amongst our animals, we had the best of prospects of keeping them free by a well-organised system of veterinary inspection and quarantine.

When one looks at the comparatively small list of the whole-time veterinary staff of the Ministry of Agriculture, with many millions of animals under their control on the slightest outbreak of any virulent disease, one must congratulate the organisation by which an outbreak is at once dealt with and controlled. This present outbreak occurred with such suddenness, and assumed such gigantic

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proportions, that for a short time it appeared almost out of hand. It is best described in the words of Sir Stewart Stockman in the address which he gave to the Council of the National Veterinary Medical Association at 10, Red Lion Square, W.C. 1, on January 9th. He stated : *

" What happened in this case was that we had all of a sudden something like twenty outbreaks, miles from each other, all at or about one time. They used up all our staff in a week or so, and we had to proceed to recruit outside men as quickly as possible. These outside men have come on in very large numbers, and they have done exceedingly fine work ; but you must understand that when you get men quite new to the job you have to do a large amount of training. I can only speculate as to what extraordinary influence operated in this invasion.

" I am inclined (and I put it forward purely as a speculation) to put it down to the fact that lately there has been an enormous spread of foot-and-mouth disease in the Argentine, and we have been getting a lot of foodstuffs from the Argentine. I venture to suggest only that our multiple invasion is due to some consignment of material dumped into this country from the Argentine or elsewhere. However, that is pure speculation for the purposes of investigation. . . .

" It brings me, however, to the real start of this outbreak—the influence that has affected Cheshire. If we took every area affected, bar Cheshire and a part of Salop, I should have no anxiety in dealing with them, and I do not despair of Cheshire, but the difficulty in Cheshire is great. We had a number of animals at one of our ports, and whilst they were there an outbreak occurred near Blackpool. A veterinary surgeon went over and diagnosed the case, and the next day there was an animal sick of milk fever in the port. It had done its quarantine. They called in the veterinary surgeon who, unfortunately, had been the day before at the outbreak of foot-and-mouth disease. He attended an animal, and in the ordinary course of things the animal went out to its destination. One of the lot, at least, arrived in the incubative stages of the disease. They passed over the railway dock and, unfortunately, almost immediately after they had done so 1,000 sheep went over. A few days later after this we knew what had happened—several of the animals, having reached their destination, went sick, and another veterinary surgeon was called in and informed us that it was foot-and-mouth disease. We suspected at first that the disease came from Ireland, and stopped the Irish

* The Address from which this abstract is made is printed in full in the *Veterinary Record* for January 19, 1924.

trade. The Irish authorities searched every farm in the district from which the cattle came, but they could not find any foot-and-mouth disease in the place. A very large number of the 1,000 sheep were distributed over the country, some going to Salop and Cheshire. We hunted them down, but to that little mistake I think we can attribute the outbreaks at Crewe and other parts. The local authority veterinary inspector forgot, or I believe he forgot, to publish an order, as he should have done at once, restricting local movement over an area when he diagnosed the case at Crewe. It was market day, and Crewe market was distributed.

"While we were in the middle of this trouble an extraordinary thing occurred. In all the twenty-two years that I have investigated this disease, and during which time I have had command of all the papers and reports, there has only once before been an initial outbreak in Scotland. For the second time it appeared in Scotland, at Paisley, amongst pigs. There had not been a movement of men or animals from anywhere to the premises. There was a history of the obtaining of green vegetables and meal from abroad, but any connection with the outbreak on that account must be pure speculation for the time being.

"This outbreak was not reported for ten days, and from that centre it was spread to many local premises, jumping even for about fifty miles, and then one hundred miles. People were tramping out and in and all over the country, and the result was we had a big crop of outbreaks before we knew where we were. The veterinary surgeon who was called in said it was not foot-and-mouth disease, but he did the right thing in going to the police and saying he was dealing with a peculiar disease.

"The spread of the disease was really due to the outbreak being concealed by the owner himself.

"To come back to Cheshire—that is the place which is giving us real concern. It has been a very difficult place to work. Cheshire is one of the most densely stocked counties, so much so that numbers of the stock have, for want of housing, to remain outside in the open, which greatly facilitates the spread of the disease. But I do not think anything helped so much to spread disease as the recent election. Every policeman was then taken off for other duty, and people were tramping about, in and out, just as they liked. In spite of this, I do not think that the position in Cheshire is hopeless. But there has been one other factor, and that is in connection with the farmers and farm labourers themselves. It has been a very difficult thing to get farmers or their employees to stay at home. They have held meetings and rubbed shoulders, the contaminated with the clean. . . .

"A farm in the north of Scotland sent some infected pigs to Newcastle, and that market resulted in about 120 outbreaks."

In our columns this month we are publishing a number of original articles showing how the disease is dealt with in other countries, and one has only to read some of them to understand how readily it may become indigenous, a prospect which every veterinarian and agriculturist prays may never be able to be said as applying to Great Britain and the Irish Free State. The latter has been on several occasions under suspicion as being the source of origin, but a study of the "Iris Oifigiuil" (which is the name in Celtic for what is termed in England the Ministry of Agriculture Report under the Diseases of Animals Acts) shows that foot-and-mouth disease has not been met with in the Free State since 1921, and the letter which we publish in full from the Ministry of Agriculture Weekly Report for February 7th (see page 135 of this issue) explains very clearly how easily it would be to blame another country unless the details were successfully followed up by properly trained and organised veterinarians. The mystery of the actual origin is not yet solved, but it is to be hoped that the British public have received sufficient fright to enable them now to see eye to eye with those who considered that money should be spent on research into the disease of animals, and that such work can only be carried out by those who are properly trained, i.e. the qualified veterinarian—as he alone must, from his training, be pre-eminent in the study and research of the diseases of animals. As illustrating this point very clearly, one has only to have read the absurd and impracticable remarks which have been offered by the man in the street, by certain old ladies, some medical men (who ought to have known better), and even by members of the clergy. As Sir Stewart Stockman stated: "The majority know too much to speak, the minority know too little to remain silent."

The daily press has now veered round to a sensible view of things, and one really wonders, in looking back on the statements which have appeared, some of them even from the editorial pens, how they can have allowed such blatant and absurd notions to emanate from the pens of the correspondents to whom they entrust their articles on Animal Diseases. One would have thought that the first thing that an editor would do would be to look around for a man who, at all events, knew something about the habits of cattle in health. One can excuse them for knowing nothing of them in disease, but one cannot excuse them for misleading the general public into the idea that the veterinary profession not only did not know its job but was prompted in its methods by ideas of mediæval origin. It has only

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been of late that they have found out that the principles upon which a cattle disease is dealt with rests upon an economic basis which implies "the greatest good for the greatest number," and it is almost entirely a question of L.S.D. Their criticism was destructive and not constructive, they gave the impression to the lay reader that they were out to criticise and not to help, and to the members of the veterinary profession they simply showed the grossest of ignorance and unfairness.

Two articles, however, which have recently appeared in our medical contemporary, the *Lancet*, should be read by all members of our profession who are engaged in dealing with this disease. One, a paper entitled "The Present Problem of Foot-and-Mouth Disease in England," by Dr. Arkwright, of the Lister Institute, who was one of those working on the ship which was recently stationed in the North Sea for the purpose of investigating foot-and-mouth disease under conditions of strict isolation; and the other by Dr. Beattie and Mr. Peden, of Liverpool University, entitled "Foot-and-Mouth Disease in Rats."

In science nothing is ever got without patient work and perseverance. This is particularly demonstrated in the fight against disease; and although research costs money, the results of scientific investigation have always repaid the sum expended. Preventive medicine is of as much, or even more, importance than the curative side, and one could not select a better disease than foot-and-mouth as an illustration of this. The opportunity of the late scare must not be missed for again bringing before the British public the folly displayed during the past years of starving veterinary research in this country, and it will also be for us as a profession to demonstrate that when we have the opportunities given to us we shall in return give back results which will justify the confidence imposed upon us.

The animal losses from foot-and-mouth disease and distemper alone, to mention only two of the ultra-visible virus diseases which cause the loss of thousands of pounds annually to the breeders of this country, ought to be sufficient stimulus for Government grants to be given to the veterinary profession for research in this direction, and this without further delay.

COMMITTEE ON FOOT-AND-MOUTH DISEASE.

It is announced in the Weekly Report of the Ministry of Agriculture and Fisheries, dated February 7, 1924, that the Minister of Agriculture and Fisheries has decided to appoint a small Committee to examine into the circumstances of the recent outbreak of foot-and-mouth

disease, to review and report upon the slaughter policy and the procedure adopted by the Ministry of Agriculture, to advise whether any further precautions should be taken to guard against the introduction and spread of the disease, and to consider whether a scheme of insurance can be devised as an alternative to the existing system of compensation for slaughtered animals.

The Committee will consist of the Right Hon. E. G. Pretyman (Chairman), Mr. Walter Smith, M.P., Parliamentary Secretary to the Ministry of Agriculture, Mr. H. German, and Mr. Alexander Batchelor.

THE POSITION ON FEBRUARY 7, 1924.

Weekly Report of the Ministry of Agriculture and Fisheries dated February 7, 1924, states that the disease reached its height in December, when 1,261 premises were found to be infected. The figures of outbreaks for the previous six weeks were 320, 256, 193, 115, 56, 61 respectively. New centres of disease appeared during the previous fortnight in Middlesex, Essex and Ayr.

Since the commencement of the present series of outbreaks on August 27, 1923, the numbers of infected premises declared and animals slaughtered and the expenditure incurred up to February 6th have been :—

Total number of outbreaks in Great Britain 2,528

Number of counties affected .. .. 34 in England, 2 in Wales and, 11 in Scotland

	Cattle.	Sheep.	Pigs.	Goats.
Total number of animals slaughtered or authorised to be slaughtered ..	86,540	29,537	39,619	108
		Cattle.	Sheep.	Pigs.
Percentage of animals slaughtered to total animal population of Great Britain ..	per cent.	1·2	0·14	1·4

Estimated gross compensation payable for animals slaughtered £2,748,000
Estimated receipts for salvage of healthy carcases £352,300

FOOT-AND-MOUTH DISEASE AT THE SECOND INTERNATIONAL CONGRESS OF COMPARATIVE PATHOLOGY.

FOOT-AND-MOUTH DISEASE is one of the subjects on the agenda of the forthcoming meeting of the Second International Congress of Comparative Pathology to be held in Rome between the 27th of April and the 4th of May. Professors Vallée and Carré, of the Alfort Veterinary School, are to open the discussion. Professor Perroncito, the distinguished Professor of the Tunis Veterinary School, is President, and a full agenda paper, with all further particulars, can be obtained by any member of the profession upon application to the Secretary of the British Veterinary Section, Mr. Frederick Hobday, 165, Church Street, Kensington, London, W.

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General Articles

FOOT-AND-MOUTH DISEASE IN THE ARMY AND ON ACTIVE SERVICE.

By Major-General Sir JOHN MOORE, K.C.M.G., C.B., F.R.C.V.S.

It falls to the lot of all Army veterinary officers at one time or another to encounter foot-and-mouth disease. A considerable period of their service is spent in India, where the disease is enzoötic. It constantly crops up amongst siege train, and army transport bullocks, or in dairy farms in contonments during the quiet times of peace, and it is ever an accompaniment of active service on the frontiers where bullock transport is used. Army Veterinary Service may therefore be held to be experienced in regard to the disease, and especially in methods of control and prevention.

By reason no doubt of its enzoöticity, the disease as a rule is of a very benign character in India, and particularly when outbreaks are more or less confined to local areas; but like rinderpest, the other great scourge of India, virulence is more intense in the case of animals not native to districts infected, as, for instance, Mysore and Scindi animals of the south brought to northern areas.

In ordinary times death is quite exceptional, the disease running an easy course to recovery in from ten to fifteen days with little loss of condition. It is in the records of active service that mortality from the disease is found, and even then it is not high relatively.

Infection is usually conveyed or distributed by affected animals themselves, but infection may be brought to a unit by bhoosa * from an infected district. The latter and the free movement of all cattle, including stray cattle, along cantonment roads are usually responsible for outbreaks amongst animals in military service, such animals being cattle and buffaloes. Newly purchased animals from district fairs are frequent introducers of the disease into cantonments, and outbreaks more commonly prevail in the spring or early part of the year during the time of movement to fairs, and the making of bhoosa after the wheat and barley harvest.

Incubation in India is from twenty-four hours to three or four days, generally thirty-six hours, and it is shorter in hot weather than in cold. The symptoms are just the same as in other countries, with the exception that at times they are milder and less definite. Sometimes the mouth only is affected, at other times the feet only. Often the first noticeable sign is lameness.

At the outset a certain amount of differentiation with the disease rinderpest is necessary by the veterinary officer. Foot-and-mouth

* Bhoosa is wheat or barley straw broken by bullocks treading out the grain, the common way of "threshing" in India.

disease as found in India is not attended by purging, whereas in rinderpest, diarrhœa and dysentery are invariable accompaniments. In the latter disease the feet are not affected, and of course its gravity is soon apparent.

Experience has shown that one attack does not confer immunity for more than five months, so that animals may suffer several times from the malady. Probably the chief channel of infection is ingestion, contaminated food and water readily producing the disease; but in view of our imperfect knowledge of the elusive ultra-microscopic and filter-passing causative organism, other viœ, notably inoculation of the mucuous membrane of the mouth, or similarly of the feet, by contaminated articles, or of the udders of cows by the hands of the milker, must not be excluded, and especially when measures of control have to be enforced. It is, however, certain that the slightest amount of virus is sufficient to communicate the disease in bovines which are extremely susceptible.

CONTROL.

In outbreaks of any contagious disease amongst Army animals, whether at home or in India, control is left entirely to Army Veterinary Service, and regulations are framed accordingly. In India occurrence is reported by telegram to the Administrative Veterinary Officer of the Division or District for action, and to the Superintendent or Head of the Civil Veterinary Department of the Province in which the military division is located, for information. Measures taken in control are instituted at once by the veterinary officer in charge of the unit affected, who keeps the officer commanding the station informed of the measures taken and the progress of the outbreak. The Administrative Veterinary Officer usually makes an inspection to ensure that measures are in order, and a fortnightly report of progress on a special form is sent to him, a copy of which is forwarded to the Director of Veterinary Services for his information and for statistical record. The measures commonly adopted follow the line of group isolation, treatment and disinfection, and briefly are as follows:—

(1) *Group I.*—Removal of all affected into isolation as far distant as circumstances admit, and away from public roads. Isolation is absolute so far as attendants are concerned, any necessary visitors such as the veterinary officer or N.C.O. taking the usual precautions in respect to disinfection before leaving the picket. Care is also exercised that no grain should be left lying on the ground to attract birds, etc.

(2) *Group II.*—Isolation of immediate incontacts, i.e. animals on either side of the affected, and washing them with disinfectant solution, particularly parts likely to have been contaminated by saliva.

(3) Careful inspection of the remainder of animals for first symptoms

of the disease, the clinical thermometer being indispensable. Inspections are repeated twice daily, and any animals found affected are removed to the isolation lazarette (Group I).

(4) *Group III.*—Change of entire standings to admit of proper disinfection, removing the apparently healthy to clean ground.

(5) Change of water supply or system of watering, the common water-trough or original means of watering being placed into disuse.

(6) Inquiry into original source of infection, and action accordingly.

(7) Thorough disinfection of standings, line equipment, carts, etc., according to rule ; destruction of tainted fodder, etc.

(8) Treatment of affected.

(9) It is very important to adopt the group system as above. If Group III remains free from disease for seven days, the animals of that group may go to duty in what is termed " working isolation." If the immediate incontacts (Group II) also remain free after seven clear days, they may rejoin Group III. " Working isolation " up to the date on which a unit can be declared free is a most convenient and satisfactory arrangement, overcoming a situation which otherwise would prove vexatious. It means that animals work as usual with the following exceptions :—

(*a*) They are not to use the same water-trough as other animals.

(*b*) They are not to mix with other animals.

(*c*) Frequent inspections are to be made.

(*d*) No interchange of attendants or equipment is to be made.

It is a form of precaution indispensable in epizoötic lymphangitis, which carries a long incubative period, but it is made applicable to other contagious disorders.

(10) A fortnight after cure of the last case all recovered animals can be returned to their unit, and the outbreak declared at an end. Precautions with regard to disinfection of the animals and attendants are not lost sight of. This period is shorter than what would be safe or necessary in other countries, but in India the conditions of heat and more or less open standings favour the impairment and destruction of the virus which experience shows is of a fragile character on the whole outside the animal body. The administrative veterinary officer, however, has always the power to extend the period of working isolation if he thinks such course necessary or advisable, and in practice it is often cautiously followed.

Foot-and-Mouth Disease on Active Service.

Under present circumstances of State machinery for the control of contagious disease in India, it is quite certain that no military force taking the field and using bullock transport, can exist for long without being inconvenienced with foot-and-mouth disease. It has been the

experience of all frontier expeditions as the following examples show: In the Chitral Relief Force, from April 1st to August 31, 1895, there were 3,675 cases, of which 151 died and 95 were destroyed, the average time under treatment being from 10 to 14 days. In the Tirah Expedition, from October 1, 1897 to April 6, 1898, out of 13,727 bullocks employed there were 1,378 cases, with 45 deaths and 3 destructions. On the Tibet Mission, 1904, there were a great number of cases, and it prevailed amongst the yaks as well as amongst the bullocks. In the North-West Frontier Force Expedition of 1919, from May to September, there were 778 cases in an average of 3,676 bullocks employed, and an isolation picket in the Khyber Pass was raided by tribesmen and 39 animals carried off. 417 cases occurred in a bullock corps (880 strong) from Southern India with Mysore bred bullocks, of which 19 died, the mortality being due more to the intense heat of the end of June and July than the actual disease itself (121° in the shade one day and heat-stroke in men and animals was frequent); the same corps suffered heavily from rinderpest. In the Warizistan Force, from June 1919 to May 1920 there were two outbreaks, one in June 1919 and the other in February 1920, the total number of cases being 2,430 in an average strength of 9,700 bullocks. The Administrative Veterinary Officer of the force in his final report remarked that "dividing stages of bullock convoys by pony and mule convoys confined it to some extent, but in dry climate, with strong winds, birds, dogs and other carriers, control becomes extremely difficult." Usually the disease runs concurrently with rinderpest, or at all events if the veterinary officer has not one to contend with, he has the other to engage his attention. There is, however, the hope of comparative freedom from rinderpest in working animals in the future by the adoption of the serum-simultaneous method of inoculation before animals join a force, but not so with foot-and-mouth disease, against which no durably preventative inoculation exists. Close inspection, the usual group isolation of affected units or withdrawal, and treatment are all that the Veterinary Service has to advance in control. Infection is contracted in the districts traversed, or is introduced by slaughter cattle, sheep and goats, the meat rations of an Indian army being provided on hoof, and marched through the force area from railheads, and at times from still farther distant collecting centres by contractors. The various base and advanced base depots of animals for food during the late North-West Frontier, Waziristan and Baluchistan Forces gave Veterinary Service great concern, and even with the best organisation it is impossible to steer clear of visitations of rinderpest, foot-and-mouth disease, sheep-pox, catarrhal and other ill-defined diseases of sheep.

It is a great pity, and I think greatly to be deplored, that the Indian Government has not yet adopted a properly constituted Diseases of Animal Act, with convenient easy working inset orders for the various prevailing contagious diseases. As an outcome of the inconvenience and difficulties experienced by the Army during the late frontier warfare, representation was made to the Government in 1921, a scheme, complete with a simple Diseases of Animals Act, being drawn up and submitted by the Army Veterinary Service, but it would appear to have fallen by the way or have been wrecked on the rocks of " transferred subjects " to provinces. It is to be hoped that the Indian Government will revive it, and by simple legislative process will lift the country out of a morass of antiquated, " kuchparwani " and totally inadequate conceptions in the control of animal diseases.

FOOT-AND-MOUTH DISEASE IN FRANCE AND BELGIUM DURING THE WAR.

During the Great War in France and Belgium Army Veterinary Service was called to aid in the control of foot-and-mouth disease. It frequently cropped up amongst the cattle of inhabitants in the areas occupied by our troops, and although the usual orders and notifications were issued by the French Ministry of Agriculture and action taken by the Ministry was sufficient to meet the circumstances, yet in the absence of so many French veterinary surgeons on mobilisation it was arranged and it was understood that officers of our Veterinary Service were to render advice and assistance to inhabitants whenever occasion required; and this was very readily given. Outbreaks of contagious disease were notified to the Director of Veterinary Services by the Mission Militaire Française, and were transmitted to the Deputy Directors with armies. The frequent occurrence of foot-and-mouth disease in the areas of our armies, and the danger of infection being carried to Great Britain and Ireland by men proceeding on leave, necessitated the publication of a General Routine Order in respect to the disease, the terms of which are given below :—

EXTRACTS FROM GENERAL ROUTINE ORDERS AND INSTRUCTIONS

BY

FIELD-MARSHAL SIR DOUGLAS HAIG, K.T., G.C.B., G.C.V.O., K.C.I.E.

PART I.

(*Adjutant-General's Branch.*)

FOOT-AND-MOUTH DISEASE (G.R.O. 1058 and 1118).

As occasional outbreaks of foot-and-mouth disease in cattle in the areas occupied by our troops have been reported to G.H.Q., it is necessary

to exercise reasonable care to avoid contagion of the disease being introduced into Great Britain and Ireland by individuals proceedings home.

The following precautions will be observed :—

1. Farms at which the disease has been notified should, if possible, be vacated by troops and placed out of bounds.

2. Commanding officers will make arrangements with the A.D.M.S. of the Division concerned for the disinfection of the clothing, boots, arms and accoutrements of all officers and men who have been billeted in farms infected with the disease, and will be held responsible that no officers or men who have been exposed to infection are permitted to proceed to England without this being carried out. Where disinfection is impossible, a fresh issue of clothing will be made.

3. Particular attention will be paid to the disinfection of boots and sticks, infection being easily carried by such articles.

4. For guidance, notification of the existence of the disease in particular localities will be made from G.H.Q.

In areas where foot-and-mouth disease has been notified, troops should be strictly forbidden to use unboiled milk, and the purchase of butter and cheese prohibited.

The Order was first published in August 1915, and it was repeated in every Book of Extracts of G.R.O.'s right up to the end of the war. The Board of Agriculture returns of incidence of the disease in Great Britain and Ireland during that period are also quoted for comparison :—

SUMMARY OF RETURNS OF FOOT-AND MOUTH DISEASE.
BOARD OF AGRICULTURE.

Year.	Great Britain.		Ireland.	
	Outbreaks Confirmed.	Animals Slaughtered as Diseased or Exposed to Infection.	Outbreaks Confirmed.	Animals Slaughtered as Diseased or Exposed to Infection.
1916	1	73	—	—
1917	—	—	—	—
1918	3	40	—	—
1919	75	3,437	—	—
1920	93	11,373	—	—
1921	44	3,085	7	77
1922	1,058	50,321	—	—

On the retreat of the enemy and return of refugees after the Armistice the disease was rampant in Belgium (Brabant and Hainault). Districts were in a chaotic state ; there were few Belgian veterinary surgeons, the majority being under mobilisation or absent, and disinfectants were non-procurable. With a view to a combined action in control, the Belgian Ministry of Agriculture approached the British

General Headquarters to ascertain if the Director of Veterinary Services of the force could visit Brussels to confer with the Chief Veterinary Officer of the Ministry and to see the Chef du Service Vétérinaire of the Province du Nord at Lille, on the way, for any action suggested by him. This was done, and the result of the interview was that officers of our Army Veterinary Service, both administrative and executive, were placed at the disposal of the inhabitants for any necessary advice and assistance. Senior administrative veterinary officers located near Brussels made a point of visiting the Chief Veterinary Officer of the Ministry to report progress. Disinfectants were supplied from our force on repayment, and were distributed by divisional trains and mobile veterinary sections. Similar action was to be taken by the French Armies on our right and the Belgian Army on our left until order could replace the chaos which abounded. The Chef du Service Vétérinaire of the Province of Nord instituted a cordon in the province to safeguard the contiguous province of Pas de Calais. Of course, when demobilization became general all measures taken by our force ended, but the situation for some time was an ugly one, and demanded all the aid Army Veterinary Service could give. There can be little doubt that the severe visitations of the disease which Great Britain has experienced since the war are the direct results of the heavy incidence which from force of circumstances prevailed on the Continent on the cessation of hostilities and the struggle to return to the normal.

In conclusion, assuredly enough has been said to point the urgent necessity for applied study and research into the factors governing the causation and spread of this insidious disease, and indeed into other serious animal diseases of a communicable nature. Moreover, it cannot but be acknowledged that the proper authority to carry out investigation and research is that service or department which is specially trained in animal diseases, and whose daily task is set in association with animals. I believe that our forces can be best marshalled by the creation of a Diseases of Animals Research Council or Board which will co-ordinate effort, collaborate with other research bodies, and systematically publish the results of its operations, so that light may eventuate from the darkness in which we are at present surrounded. It is up to the rising generation of the veterinary profession to perfect the path of research which is essentially its own : the older members can supply the experience, and under its guidance suggest the administration best calculated to achieve the happiest results in the control of disease, and the limitation of the cost to the State which such disease entails.

FOOT-AND-MOUTH DISEASE IN INDIA.

By Lieut.-Colonel BALDREY, C.M.G., F.R.C.V.S., D.V.H.
(*Late Royal Army Veterinary Corps.*)

History.

Like the poor, foot-and-mouth disease would appear to have been always prevalent. It recurs as regularly as the seasons, and is accepted much in the same way by the inhabitants of India. Local records mention it under various terms, mostly signifying an affection of the foot or mouth, or both, and speak of it as we do of cow-pox. No great significance is attached to the disease, as it seldom assumes a very virulent type.

Distribution.

The disease is distributed throughout the Peninsular, and is common to all localities. Its virulence is probably greater in the hills and the highland country of Central India. It is an indigenous vesicular disease with an acute febrile onset, very highly contagious, and frequently assuming epidemic characteristics.

Etiology.

The specific cause is the widely distributed filtrable organism, but apart from this there appear to be subsidiary causes of a seasonal nature. The recurrence of the disease is particularly noticeable at the commencement of the hot, dry season, the beginning of the rains, and again at the end of the rainy season. This seasonal prevalence is not so much the result of the weather, as the general movement and migration of stock, which takes place at these times. When, owing to the heat and drought in the plains, grazing becomes scarce, there is a general exodus of cattle to the highlands of Central India, the huge jungle areas, and the foot hills of the higher ranges. There it is cooler, water is more abundant, and the grazing is infinitely better. So soon as herds begin to travel on the cattle routes, and congregate together in grazing areas, foot-and-mouth disease becomes prevalent, and rapidly spreads. The same thing happens upon the return of stock to their original villages. This periodic infection is attributed by the natives to the friction and wear upon the feet imposed by travel, such infection being conveyed to the mouth by animals licking their painful pedal extremities.

The following is an extract from an article I wrote in the *Agricultural Journal of India* some years ago :—

"In the case of foot-and-mouth disease, movement of cattle may be seen to be the direct cause of the spread of infection. From the beginning of the rains until the roads become open in October there is very little traffic in grain, timber, cotton, fodder, and other produce,

and carter's cattle are mostly idle in grass, birs, etc. As soon as the road becomes passable the traffic recommences, and there is a large admixture of animals from widely differing centres at the various roadside camps. The same thing applies to Bunjaras and Ahers (dealers and breeders), herds which commence moving either for fresh grazing, or for sale at the various markets. Cattle which have become immune to the local infection of foot-and-mouth disease are then exposed to different strains of the disease, and at once become infected. It is for this reason we note that foot-and-mouth disease commences in epidemic form in November and December, and gradually gets worse until the end of the hot weather, when traffic again ceases."

INCUBATIVE COURSE.

Two to three days usually, but may extend to ten or twelve. As a rule, the longer the incubation the milder the attack. The infection is usually of a mild nature. Lameness is evident as a primary symptom, followed by the excessive salivation due to the vesicular eruption in the mouth. The symptoms evinced in the rainy season are usually more pronounced, particularly the lameness. This is due to the fact that mud and moisture tend to set up a secondary inflammatory condition in the ruptured vesicles in the cleft of the foot, the heel and the coronet. Occasionally further complications arise and suppurating ulcers result, and may cause separation of the horn.

Prior to any ordinary symptoms noticeable to the casual observer, there occurs the initial febrile attack. A fairly severe rigor and a temperature of 104–105°. The animal stands with back arched and coat staring. The rigor is of short duration, probably only an hour or so. Lameness at this time will be apparent, but no vesicular eruption. This lameness is evident, while the animal is standing, by its constant changing from one foot to another, and occasionally shaking or kicking, with an apparent endeavour to remove something from the foot. In twenty-four to forty-eight hours vesicles appear in the cleft of the hoof, at the top of the heel pad, or at the coronary band just above the hoof cleft.

The buccal vesicles usually appear concurrently, or follow immediately the foot lesions, and most commonly affect the surface of the tongue, the inside of the lips and the gums. The vesicle is characteristic—flattened as to surface and a dead white. Upon its rupturing a raw surface is exposed, shallow, flat, and with the edge of the membrane distinctly outlined. There is no tendency to ulceration, and resolution commences almost at once, so that in a few days healing has progressed considerably. It is characteristic of the disease that

so soon as the vesicles rupture acute symptoms pass away, and the animal endeavours to feed. In the milder form, so prevalent in India, it is not essential that the vesicular stage is pronounced. It may be so slight as to be hardly noticeable. There is, however, always a tendency to salivation of the characteristic ropy consistency in cattle. In sheep the disease is modified to an even greater extent. Salivation is rarely evident; the vesicular eruption usually attacks the gums or dental pad, and is much more common in the feet than the mouth. I have seen working bullocks so lightly affected as to be able to continue their work, but it is not often so mild as this. There is always, even in mild cases, a certain amount of loss in condition, but as affected animals receive no nursing or particular attention this is not to be wondered at.

INFECTION.

Appears to be by actual or subsidiary contact, but our knowledge on this subject is primitive. Conveyance of infection is said to be possible by air medium for a distance of 200 yards; conveyance by the clothing of individuals, and actual contact with affected animals is recognised, and probably the most important means of transmission. What we are in ignorance of is the location of the infection between outbreaks. The periods of quiescence are not explainable. Investigation is necessary as to the probabilities, or possibilities, of it being carried by means of ticks, fleas, flies or lice. We know that the organism is a delicate one, and easily succumbs to mild antiseptics, light and desiccation. It is most difficult to keep it alive for any experimental work. Repeated trials to reproduce the disease from the fluid evacuated from the mouth have been abortive, and it would appear that the infection from the beast is only possible up to the time that the vesicles rupture. That is, that the period of infectivity is from the initial rigor and febrile stage until the rupture of the vesicle, viz. the first three to four days after incubation. There may be an analogy to rinderpest in this. We know that the greatest virulence of this latter is at the sixth day, and possibly the acutely virulent nature of the foot-and-mouth organism is only obtainable from the affected animal for probably a few hours during the first onset of the disease.

As to how the infection is exuded (if I may use such a term) is not understood. I have remarked before that lice may be a possible intermediary agent, though the alarming rapidity with which attendants, their clothing, etc., become the means of carrying contagion is not explainable by this means. I read in the daily press that Liverpool workers have found the glands of contact cattle infected with what appeared to be foot-and-mouth disease. This is, of course,

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possible. In the initial stage of the disease, that is, during incubation, a generalised infection is progressing and possibly an acute septicæmia results, in which case infection would be obtainable from any part of the body. This would also, to some extent, explain its virulent nature during the early stages, as all excretions from the body would be capable of spreading it, i.e. respiration, perspiration, saliva, tears, and possibly urine and fæces.

Investigation on these lines appear to be indicated, as it bears so practically upon the question of early slaughter, as a comprehensive stamping out measure. It is the contacts which require attention rather than the visibly affected animals. The introduction of the disease from outside sources does not apply in other than insular conditions, where actual stamping out is possible, and what one may describe as the carry over period between outbreaks has not so far received any satisfactory solution. By this I refer to the vexed question as to where and how the organism exists during its non-parasitic existence. The fact that it is so easily killed would lead one to suppose that it is not facultative in the ordinary sense, and supports the possibility of a living host carrier.

Introduction from a foreign source may be by migrating birds, as has been suggested, but this is supposition and has not a single fact to substantiate it. The importation of straw, packing material, feeding stuffs, etc., from affected areas is very much more probable, but none of this accounts for its introduction over wide areas in India, where the importation of any of the above is unknown, and the migrating bird theory is negligible.

It would appear that there is some abiding place of which we are ignorant. It may be that some animals, incapable of infection, act as carriers for a considerable time, or that certain ruminants immune themselves are carriers, as is the case with typhoid in man. The recent work at Liverpool indicates the possibility of rats being carriers, possibly for an indefinite period, and this again points to such probability in recovered bovines or other ruminants. Deer, antelope, etc., do not appear susceptible. On the other hand, the possibility of their being carriers cannot be eliminated. So soon as the disease becomes epidemic, its spread is possible by birds, vermin, attendants, and, in fact, by many ways.

I referred in the early part of this article to the variation of strains in the foot-and-mouth organism. There is no doubt that animals capable of withstanding infection in their own neighbourhood quickly succumb when moved to a distance and a new locality. It would seem that there is a considerable variation in valency and that different strains have varying powers of infectivity. On the other hand, an

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animal travelling any distance, whether by road or rail, has its powers of resistance lowered by the journey. Lingard demonstrated this in the case of Surra. Equines in which the organism could not ordinarily be found were easily demonstrable after a long railway journey.

Mortality.

Under ordinary circumstances the death rate is very low, probably not more than 2 per cent. of attacked animals. On the other hand, as already pointed out, complications are numerous, and the tendency for other and more fatal diseases to supervene on the weakened vitality is very great. Excessive rains and storms are also responsible for fatalities in animals so weakened. Naturally, immature stock suffers the worst, and quickly succumb if the weather conditions are rigorous. For this reason a widespread epidemic of foot-and-mouth disease may cause immense losses.

Immunity.

One attack confers only a temporary immunity, and it is not uncommon for animals to suffer twice in the twelve months. It is for this reason that vaccination on present known lines is not a practical proposition, but indicates the necessity for a serum which would give to an animal the power of resistance necessary to establish only a mild attack. Naturally the serum would only be of use in the presence of an outbreak, and repeated injection would be essential, at intervals, during the epidemic.

Complications.

Foot-and-mouth disease in itself is not of a very serious nature in India. It, however, becomes an acute problem in that land, which has such a host of virulent infections. The plains cattle have by generations of exposure to rinderpest, piroplasma, etc., acquired a considerable amount of immunity to these diseases, and if attacked by any one singly stand a fair chance of recovery. If, however, foot-and-mouth disease supervenes, or is already epidemic, they are unable to withstand the dual attack, and if they do, emerge such emaciated wastrels as to be of little use. Pregnant cows and ewes which are attacked almost invariably breed poor stock. It must be remembered that special diet and nursing are not adopted. If such care were taken there would not be the same serious effect. In the Laboratory at Muktesar we found foot-and-mouth disease one of our greatest plagues. In spite of most elaborate precautions, it occasionally gains access to the animals used in hyperimmunisation for the preparation of anti-rinderpest serum, and the results were disastrous. It held up injections and bleedings, and if attacking an animal recently injected during the immunising process the results were frequently fatal.

The tendency also to troublesome sequelæ is also marked. Pneumonia is a common result, and frequently a severe mammitis in milking cattle. Neglect of the feet in severe foot cases will sometimes lead to extensive ulceration, which tends to form fistulæ in the hoof, and possible shedding of the horn. In very wet weather a fatal diarrhœa may supervene.

TREATMENT.

This may be summed up in a few words. Isolation, strict cleanliness and judicious nursing. Medicinal applications other than simple antiseptics to the local lesions is not necessary. Feeding on easily masticated food, and subsequently a general tonic usually suffices. In sheep a foot bath of a weak astringent antiseptic may be used, but with cattle a spray is sufficient. If animals are in shelter, constant spraying with an antiseptic is essential. The floors, walls, etc., should be done daily, and the cattle themselves with a weak solution. Any of the reliable commercial carbolic preparations with a soap base are indicated. When animals are in the open, change of ground and avoidance of mud and excessive dampness should be aimed at. Complications which arise should be treated as the symptoms indicate. Manure and all excreta should be stacked as quickly as possible, so that the process of fermentation may destroy any infection. Combings and brushings of the hair are advisable, and all such dirt removed from the coats of animals should be burnt. Meticulous care is necessary in the thorough disinfection of all attendants whenever they leave the vicinity of animals.

The Indian Civil Veterinary Department does a great deal of work in co-ordinating isolation so far as possible, and preventing movement during outbreaks. Medicinal treatment is given, and their exertions have had considerable effect in lessening losses.

FOOT-AND-MOUTH DISEASE FROM AN INDIAN STANDPOINT.

By F. WARE, F.R.C.V.S.,
Indian Veterinary Service, Madras.

To one who has been accustomed to look upon foot-and-mouth disease in cattle much as one does a mild epidemic of influenza amongst human beings, it comes somewhat as a surprise to find such a vast amount of ignorance existing in this country as to the nature of this disease.

The writer returned to England when the present epidemic was first reaching large proportions and when the lay Press was beginning to offer the profession many weird and wonderful methods of treatment for what was apparently considered to be an almost incurable disease.

It is to be hoped that the well-informed articles which appeared

later in *The Times*, *Daily Telegraph*, and other papers will go a long way towards educating the public in the matter, and will remove the stigma which the profession has undoubtedly acquired through this prevailing ignorance.

In India the question of slaughtering cattle affected with any contagious disease, for religious reasons, has never been seriously contemplated. The result is that foot-and-mouth disease is very prevalent, and in fact is often an annual occurrence in a village. Moreover, as the immunity conferred by one attack is of such short duration, the same animals are liable to infection each time. Farmers who are unable to breed their own draught bullocks rely for their supplies on the annual and weekly cattle fairs in which India abounds, and no easier method of spreading the disease over a large area of country can be imagined.

In the Madras Presidency in recent years attempts have been made to stop the spread of the disease by closing fairs in those areas in which it is known to exist, but the efforts of Government have always been defeated by the dealers, who then hawk their animals round from village to village, and the stoppage of this traffic so far has been found impracticable.

The farmers themselves, in the case of foot-and-mouth disease, cannot be relied upon to give much help, for they appear to find it difficult to understand why any efforts should be made to control so mild a disease, and in fact it often happens that an outbreak of it is not reported for the simple reason that it was not considered of sufficient importance!

Although treated in this nonchalant way by the people of India, it does cause them a considerable amount of economic loss, particularly amongst their draught bullocks. Not only do these suffer in condition, but many cases of chronic lameness and even deformity of the feet are seen as a sequel to the disease amongst animals which have not been properly treated, and there are many thousands of such in India.

As regards mortality, the official figures are probably only very approximate, but it is reported that there have been only 2,000 deaths amongst cattle on an average during the last five years in the Madras Presidency, whose cattle population is roughly 200 millions.

Considering the prevalence of the disease amongst cattle, one would expect, judging from what is found in Europe, to hear of a considerable number of human cases, but the writer has not heard of one in the course of sixteen years. This does not preclude their occurrence altogether, but it certainly would seem to show that they are not common, and this is all the more remarkable when one remembers that cattle are often stabled in the verandahs of human dwelling houses, and that milk is a much-sought-after food.

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TRYPAN BLUE INJECTIONS IN FOOT-AND-MOUTH DISEASE.

By FRANCIS A. DAVIDSON, B.Sc., M.R.C.V.S.
(*Late Veterinary Superintendent to the Ice and Cold Storage Company, Hong Kong.*)

THE conditions under which I have been working in Hong Kong are so entirely different to those pertaining in Great Britain, that I think a few notes on the position there will help the reader to understand a few of the points I shall later put forward.

Though I did some work amongst the native cattle in various parts of China, these few notes are based mainly on outbreaks which occurred amongst dairy stock (Ayrshires, Holsteins and Shorthorns) imported into Hong Kong from Britain, America and Australia. Therefore, though the disease is indigenous in China, and the native humped cattle have developed a certain degree of immunity, these dairy cattle contract as virulent a form of foot-and-mouth disease as those in this country at present.

The Company's herd of 1,000 pure bred cattle are housed on a farm on the island of Hong Kong about four miles from the town of Victoria. There are about fifty sheds, each having stalls for thirty cows and two bulls, and they were scattered all over the farm of about 300 acres in positions which afforded possible isolation from each other should disease break out in any particular one. They are built throughout of reinforced concrete and brick—including the roof—all angles and brick walls being faced with a smooth layer of cement, and the only wooden parts are two sliding doors. Drainage is by open channels to an open cement sump outside the shed, this being emptied twice daily into ordinary surface channels which carried the liquid manure to all parts of the grass land. There are no hay-racks or mangers, straw being fed on the cement floor and concentrated foodstuffs in separate wooden tubs, which are washed out after each feeding. The sheds are thoroughly washed from end to end at least once daily, and of course the soiled parts of the cows and their standings are done before each milking. It will be understood from the foregoing that a shed can be thoroughly disinfected by spraying within an hour. The only movements (except breeding ones) of the cattle are out into a small hard earth paddock attached to each shed, and the disinfection of this was very easy as the droppings were removed daily, though the sun was perhaps the best control of any outside infection. The labour for each shed was two to five Chinese cowboys, who had sleeping and cooking quarters at each shed.

It is important to note that the public abattoirs are situated only two miles from the centre of the farm, and passing into these daily would be 200 to 800 cattle from all parts of South China.

The temperatures of all the cattle under my supervision were taken usually once daily, but if there was an outbreak of any infectious disease in any particular section a special book was kept to note all the temperatures there at least twice daily.

There is no need for me to detail the animals which may contract foot-and-mouth disease. Though I had cattle, pigs, goats, and, for a few months, blackfaced sheep, on the farm, I have only had cattle affected. Undoubtedly cattle are most susceptible, though they are perhaps more readily exposed to infection than the other domesticated animals.

All members of the profession certainly know that the cause of foot-and-mouth disease is an ultra-visible virus, but there is, I am afraid, not this widespread knowledge as to its distribution throughout the body, and there is a tendency to consider it as a disease localised in the mouth, feet and teats. Though all discharges, contents of vesicles, etc., from an affected animal are infective, it is important to remember—especially from the point of view of treatment that the virus is found within the blood corpuscles at the height of the fever. When studying at the Pasteur Institutes of French Indo-China I observed the experiments of Dr. Schein, who by a process of lavage found that the corpuscle, but not the serum, was infective to susceptible cattle.

The course of infection would appear to be mainly by ingestion; the most infective period of an affected animal from the beginning of the temperature until formation and rupture of the vesicles; and the chief causes of dissemination amongst other stock is by labour and foodstuffs.

I found that if, immediately on noting a rise of temperature in a cow, this later proving to be foot-and-mouth disease, the following precautions were taken, there was practically little danger of spread of the infection to even other cows in the shed, and certainly none to the neighbouring sheds:—

(*a*) All movements and possible contact with other stock stopped, care being taken that there was no direct contact between this animal and those standing immediately next to her; either by removing the affected to an empty stall or isolation shed or by vacating the two adjoining standings.

(*b*) Assuring separate and uncontaminated feeding.

(*c*) Immediate disinfection of the shed and everything in it, including the cowboy's clothing.

Until rupture of the vesicles and fall of temperature, the floor of all the sheds, and the wall opposite the affected animal, was washed twice daily with disinfectant. After subsidence of the fever the

cow was washed all over with disinfectant, special care being taken with the quarters, tail, feet and head. My observations warrant me in stating generally that if rigid precautions are taken until rupture of the vesicles, and then there is thorough disinfection of everything, including the affected animals, and there have been no others infected till then, there is practically no danger of the disease spreading after this. I removed all restrictions from the sheds in seven to ten days after the rise of the last temperature, and have never had any recurrences. However, if a temperature had been unobserved for twelve to twenty-four hours—even though the vesicles had not ruptured—and there had been a labour contact with some other stock or direct contact, then one could expect to have further cases.

Of course, owing to the prevalence of the disease amongst contiguous native cattle, slaughter was not considered, and my procedure at one time was an attempt to spread the disease round the shed as quickly as possible. But this was often very prolonged, especially towards the end of an outbreak. I have given healthy cattle food which has been salivated over by cattle affected, and often these have not contracted the disease until seven to fourteen days later, when I have had definite proof that the incubation period of this outbreak was considerably less than that time. I have also taken rough rags soaked in saliva and rubbed it into the gums, and on one or two occasions I evacuated unruptured vesicles with a 1 c.c. syringe and inoculated healthy animals with, in many cases, no hastening on of general infection, resulting in a two to three months' quarantine, while the disease spread round those sheds in the area affected. Still, I think that labour and feeding play the biggest part in dissemination, as in the majority of my outbreaks the bull was the first animal affected—he being handled and led out by the nose-ring at least once daily, and in most of these cases a definite proof of the cowboy's contact with the abattoirs was found.

As regards other agents, birds, I am sure, must often act as mechanical carriers, and in one extension of an outbreak I dealt with in this country this origin was practically certain. Rats also may carry infection in the same way, but when investigating one or two outbreaks here in which the origins were obscure and the nearest outbreaks were a few weeks previous, I have often wondered if they could possibly act as "carriers" by becoming infective themselves after an attack of the disease. However, I have had rats caught on several occasions, but so far have found no clinical evidence to support this theory, though I think it worth following up, especially since rats usually leave the buildings in which much disinfectant is used.

In Hong Kong or any part of the tropics, there is a decided

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seasonal incidence of the outbreaks, and one may roughly fix a period from May to September, when it is practically certain that no outbreaks will occur—at least this was so amongst my dairy stock. The fact that the virus is easily killed by heat and sunlight will probably account for this, and any infective material exposed to these two factors would be soon sterilised.

The course of the disease is variable, the virulence decreasing with the age of the outbreak, and the length of the incubation period may be as short as thirty-six hours in the first cases, and after a few weeks extend to seven days. Vesicles usually appear in twelve to thirty-six hours after rise of temperature and rupture in a few hours. After another twenty-four hours the acute stage may be said to have passed, but the period of convalescence is generally prolonged.

The percentage mortality during the acute stage of the disease is practically nil—I only lost two cows (both in eighth month of pregnancy) over a period of two years.

I shall not refer to symptoms at any great length except as regards those found when the virulency of the outbreak is on the wane. It is then that the greatest care is required in diagnosis, as there is a tendency for some of the typical lesions to become very mild or even disappear altogether, and particularly is this so with the buccal vesicles. I have had a cow which developed a high temperature, feet and teat vesicles, later aborted, and was slaughtered for debility, but at no time showed any evidence of vesicles in the mouth or salivated. However, I have noticed that in some outbreaks, even at the commencement, when the incubation period was short and the general symptoms severe, there was a definite predilection for either the feet or mouth, and on inquiries being made at the abattoirs the native cattle were similarly affected, i.e. badly in the feet, and only slightly, or not at all, as regards the mouth, or *vice versa*. Further, these Chinese cattle had come from certain definite parts of the interior in which this variety of the disease, as far as could be found from inquiry, was typical. From this one might almost suppose that there are different strains of the virus.

Undoubtedly the controlling symptom of foot-and-mouth disease, in fact of almost any of the infectious diseases, is temperature. Though an experienced observer may " sense " something wrong before the thermometer registers anything unusual, the latter is usually the first possible means of informing one that anything is wrong. I have often at the first suspect of an outbreak had to defer a definite diagnosis for twenty-four hours after a morning temperature of say 106° F., until definite lesions of foot-and-mouth disease developed, and so ruled out rinderpest or some of the other infectious diseases.

During this time the animal did not show anything much amiss except perhaps a sudden drop of the milk supply.

Differential diagnosis of foot-and-mouth disease may at times be very difficult, especially as the temperature in the case of foot-and-mouth disease usually drops to near normal on rupture of the vesicles. Also, when at the tail end of an outbreak some of the symptoms disappear, one may be entirely misled. Therefore at all times it is necessary to make a most thorough and detailed examination before confirming, or the reverse. The diagnosis should be made on the total of *all* the symptoms and not on any particular one, e.g. salivation and buccal sores or lameness and a moist appearance of the cleft of the hoof, etc., such as I have seen done, the whole time taken being a matter of seconds.

Until recently, notes on treatment were useless to the practitioner in this country, but now that isolation of affected animals has, in some instances, been adopted, they may be of some importance. What has struck me most in my search after methods of treatment of foot-and-mouth disease is the excessive attention and instructions devoted to the lesions localised in the mouth, feet, etc., to the almost entire exclusion of any attempts to treat the cause—namely, the virus, which passes throughout the whole system. The importance of recognising it as a generalised infection (septicæmia ?) and treating the outward lesions as secondary, is supported by the high temperature, constipation, loss of flesh, fall in milk yield, general unthriftiness during convalescence, and the high percentage of abortions, dead, and "weedy" calves. It was with this in my mind, and the findings of Schein, that the virus was found in the blood corpuscles, that I one day injected a few cows at the height of the fever with Trypan Blue in the usual doses for piroplasmosis. I had been treating a few cases of the latter disease and controlling my results with frequent stained blood smears to observe the rapid action of the dye on the piroplasms, this showing that its antiseptic actions within the corpuscles were most definite. The following morning my greatest hopes from this treatment were more than realised. Instead of finding these animals lying in the distressed condition observed about the time of appearance of the vesicles, or just immediately after, I found them looking fairly comfortable except for the usual lameness and sore mouths. There was a marked subsidence of the fever, a rise in the milk yield, and fairly keen appetite for sloppy mashes. For the next few days I treated all cases of temperature, and those previously affected, with Trypan Blue, and had quite encouraging results. Then I extended this, and periodically injected all in-contacts with average doses of 1 per cent. solution.

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The proof of the value of this form of treatment was most evident amongst the animals concerned in this outbreak—about 80 to 100 head of cows and young stock. Even to the layman it was quite possible to divide the affected cattle into three definite groups :—

(*a*) Those which passed through the acute stage without any injections.

(*b*) Those treated on rise of temperature.

(*c*) Those treated before rise of temperature.

The last group, except for a few hours at the height of the fever, which was lower than usual, showed very little distress, unless they were far advanced in pregnancy.

Treatment with Trypan Blue during the acute stages considerably reduced the after-effects. There was not such great tendency to debility and intermittent fever, the loss of milk yield was less, and secondary complications, such as abortion, sterility, mammitis and sloughing hooves, followed by septic arthritis, were greatly reduced. Considering it from an economic point of view, one might say that the losses from an outbreak amongst dairy stock were reduced by at least 50 per cent., if Trypan Blue was used promptly.

As regards treatment of the mouth lesions very little was necessary except cleansing of the nostrils, etc., with hot water, soap and antiseptic. Beyond that, one need only see that the mashes are sloppy and the hay or straw damped, an abundance of salt licks available, perhaps Pot. Chlor. in the drinking water in severe cases, astringents and mouth-washes being entirely unnecessary.

In treating the hooves, the main point is an absolutely dry and clean stall ; it is not necessary to have a heavy bed of straw, which is usually comparatively wet and dirty, especially at the hind feet. See that the hoof is kept thoroughly dry and clean and no grit allowed to work in between the old and new horn—this is most important, as if this happens there is pressure, inflammation of the new tissues, followed by sepsis ; therefore it is advisable not to use sawdust or such materials as bedding, as long as the floor is not so smooth as to make rising difficult. I made it a routine procedure to have the feet of all the cattle in an infected shed swabbed daily with weak Tinct. Iod. around the coronets and in the clefts, until the new horn had grown down about $\frac{1}{4}$ inch. The weak iodine acted as sufficient antiseptic, and by evaporation of the spirit kept the wounds dry, and unless in very acute cases, with rapid separation of the horn from the matrix, bandages, etc., should on no account be used.

Tonics, etc., in some cases may be useful, but convalescent treatment should be principally dietetic, paying special attention to the mineral ration.

Undoubtedly, from a national and individual economic point of view, the most important aspects of foot-and-mouth disease are the sequelæ. It is this which has ruled the policy of slaughter in Great Britain and other countries. Yet very few people connected with live stock in this country understand just to what extent and how this malady causes loss. We hear and see reports continually that the " mortality " is practically nil, and that it is " curable " within a week or two. What is exactly meant by " curable ? " In this instance it seems only to mean an abeyance of the acute symptoms—the time specifically stated bears this out. No mention is made of the long convalescent stage, etc., and of the numbers later slaughtered as useless.

The full extent of all this can only be realised after observing a few outbreaks, treating the affected and keeping records of their subsequent history.

I shall deal with this subject as it affects dairy and breeding stock, but other classes of live stock are similarly affected, though in a lesser degree.

(*a*) The great loss of condition and the subsequent expenditure in replacing this; often it is impossible to regain condition. I have seen cows carry their winter coats for three successive tropical summers and never show any signs of " casting." Any person connected with stock will realise what this means, and in every outbreak one gets a fair percentage of these typical " bad-doers."

(*b*) The milk yield during the lactation period, in which the cow is affected, is usually reduced from 40 to 70 per cent., and it is seldom that a cow will ever reach her previous standard in any future period; besides which they dry off some considerable time before the next calving.

(*c*) The hoof lesions always lead to a certain number of cases of arthritis, especially in heavy cows, and a large percentage of these have to be slaughtered. Bulls are of little use until their hooves have sloughed off, and then usually their vitality is considerably impaired.

(*d*) Abortion is a common sequel, and of those calves calved full time, a large number are dead, die within a few days, or are weakly. Retention of the placenta is the rule at calving, and partly accounts for the greater number of the cases of sterility which crop up after this disease has attacked a herd of cows, and amongst young stock affected a few subsequently prove sterile. All cattle so affected —i.e. sterile and dry, are only of use for slaughter.

(*e*) Mammitis and bad teats are features of this disease, and always result in loss of some quarters and permanent reduction of milk-yield.

These are a few of the main sequelæ of the disease, and at a glance

they do not seem very serious to the unobservant and untrained mind. However, if the losses are reckoned up in actual cash figures, the seriousness of having foot-and-mouth disease passing through the whole country and periodically affecting the cattle, etc., is immediately evident. Briefly it is this: total loss of milk, etc., during fever stage, subsequent permanent drop in milk and beef, cost of treatment and extra feeding, lowered percentage of healthy calves, number of animals ultimately slaughtered as useless. It is really impossible to estimate with any degree of accuracy the total loss which would be incurred yearly by any country in which foot-and-mouth disease is allowed to spread without hindrance, since the worst effects do not appear until months after the acute stages of the attack. Therefore, if one puts a nominal loss per head per year on all the stock in countries in which the policy of slaughter is adopted and compares this with the total cost yearly of slaughter, the economic gain from control by slaughter is self-evident, as only a very small part of the live stock become affected yearly.

Referring to our high-priced pedigreed herds, it seems to me that the perseverance of this policy is as beneficial as to any other section of the live stock trade. The present inflated prices paid for this class of animal is in no small measure due to a keen export market. If foot-and-mouth disease rages throughout the country, many of those outlets will be closed to our breeders; both owing to risk of importing the disease along with the cattle and because the latter will be poorer both in productive powers and constitution.

The working conditions in Hong Kong allowed me to deal with outbreaks very effectively, and, taking my last six outbreaks, they were all confined to the original shed (each housing thirty cows). In one case only three animals were affected, and in each of two sheds two cows; and in the remaining three, one animal each. In all of these the cows were first noted on temperature, and of course immediately all precautionary measures of disinfection, etc., were put in force and all the cattle injected with Trypan Blue, and though the latter seemed to have some controlling effect, my general observations on its actions as regards foot-and-mouth disease do not permit me to say that it is specific for this disease, and that most probably the prompt isolation, etc., played the most important part in stopping the spread. In fact, if I had had any more outbreaks it was my intention to attempt control by either serum from a recovered case or by simultaneous vaccination of virus (blood from case just before rupture of vesicles) and serum. This latter method, I think, if successful, will prove to be the most useful in those countries where the disease is rife amongst the native stock, and it is necessary to protect valuable

herds such as that of The Dairy Farm Company, Hong Kong. Though the immunity conferred appears to be comparatively short, yet it seems to me possible to revive this from time to time by injections of virulent blood, roughly at the time the animal would be becoming susceptible.

In one outbreak, about March 1922, I had a case of foot-and-mouth disease in a bull which, owing to the carelessness of a Chinese foreman, was not reported until all the vesicles were ruptured—the cows in the same shed were part of a consignment from Scotland about March 1921. The latter had all become affected with foot-and-mouth disease after leaving Genoa on the voyage out to Hong Kong. As there had been at least two days contact with the bull while he was infective, before I had opportunity to prevent further spread I expected the cows to become affected, especially since the bull showed very severe symptoms of a virulent attack, but none showed any symptoms. So possibly there may have been an immunity as a result of the attack about twelve months previous. This opinion was strengthened later when in another shed—this time cattle bred on the farm and known never to have been affected—there was a delayed report, and all the cows, except one, became affected within a few days of the first report. This last outbreak was very interesting from two other points. First, the type of shed being obsolete was probably conducive to a rapid infection of all the cattle. In shape it was octagonal, with the cows facing inwards towards an open central space, in which all the food-stuffs were put, so that any infective cow would contaminate this small space in a very short time, and therefore all the food-stuffs deposited there. Secondly, this shed was separated from the next by a 10-foot passage, which was the common exit for both, and in which the only water-tank was situated. But the cows in the latter did not contract the disease.

This brings me to a point which, I think, is very important in helping one to decide at the commencement of an outbreak just what danger there is of further extension of the infection, and what restrictions are to be put in force on a farm ; or, if in this country, should partial slaughter be attempted and isolate the remainder of the stock ? If one is satisfied that any part of the stock have not been subject to a direct labour or feeding contact with the affected cattle, no matter how near the two lots are, and other conditions are fairly reasonable, one may justly give the healthy a chance. Especially is this feasible with pigs. In Hong Kong I never had an outbreak amongst the 400 to 500 pedigree and cross-bred pigs reared on the farm, probably because there was very little contact between

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them and the cattle as regards labour, feeding and housing. However, it is also worthy of note that monthly I had 200 to 350 native pigs passing through the feeding sheds to meet the local pork trade, and at no time did I notice any evidence of foot-and-mouth disease; but in China the pig and the ox come in contact very little. In October 1922 thirty-five Ayrshire cows and twelve Berkshire and Middle White York pigs were shipped from London to Hong Kong. All the cattle became affected with foot-and-mouth disease during the voyage, possibly infection from Great Britain, but none of the pigs—the cattle standings and feed were separated from the pigs, but the labour was the same. In one case of isolation which I have visited in this country the affected cattle were situated in the same yard as over 100 pigs, and the latter were not slaughtered out until about fourteen to sixteen days after the first case was reported, but they all remained healthy until slaughtered.

Under the conditions found in this country, the handling of outbreaks as I did in Hong Kong are practically impossible. The average farm or cattle shed is usually comparatively dirty and untidy, walls and floors very unsound, and the arrangement of the buildings irregular, with too many outhouses, and also large quantities of food are scattered about. Also movements are very numerous and indefinite, and the case has been in the infective stage for some time before the report is received and action taken. Therefore there has usually been decided spread of the infection in all directions, and if markets are implicated, whole counties may have foci of infection throughout their whole area, owing to the present-day facility and rapidity of transport.

Considering these last facts, and knowing the great losses from cattle affected, I am fully convinced that the policy of slaughter and compensation is up to the present the best, both from the national and individual point of view. To the country the stock, free from foot-and-mouth disease are far of more value, as a food-producing unit, and all the markets of the world are open to our pedigreed stock. As regards the individual owner, surely it is better for him to be able to start off in a few weeks with a smaller *but healthy* herd than to carry on with animals which at the best are an eyesore and of greatly depleted value; beside being cut off from his usual business routine for a considerable time.

N.B.—Since this paper has been commenced I have had an opportunity of observing foot-and-mouth disease in three pigs, which goes to prove my statement that towards the end of an outbreak when the incubation period is lengthened one may find great variation of the symptoms.

1. *Boar.*—Incubation probably 3–5 days.
   10 a.m. 8/2/24—healthy in every way. Temperature normal.
   10 a.m. 9/2/24—very lame in left hind foot, otherwise healthy. Temperature normal.
   3 p.m. 10/2/24—Temperature 105° F., more or less lame on all feet, but no vesicles. 10 p.m.—vesicles all four feet.
2. *Black Sow.*—Incubation 4–6 days. 11/2/24 healthy.
   10 a.m. 12/2/24—very lame one fore foot. Temperature normal.
   5 p.m. 12/2/24—very lame one fore foot. Temperature normal, appetite good.
   9 a.m. 13/2/24—lame three feet. No appetite.
   3 p.m. 13/2/24—Temperature 103° F. Vesicles all four feet and muzzle.
3. *White Sow.*—Incubation 4–7 days.
   5 p.m. 12/2/24—healthy.
   9 a.m. 13/2/24—lame on two feet.
   3 p.m. 13/2/24—temperature normal, no vesicular formation on feet, but decided lameness and slight congestion. Typical vesicle on muzzle.

THE FUTURE CONTROL OF FOOT-AND-MOUTH DISEASE.

By Lieut.-Colonel RAINEY, C.B.E., M.R.C.V.S., F.Z.S.
(*Late Royal Army Veterinary Corps.*)

It is far from the object of the following remarks to criticise anything that has been done in the past, and is now being done, to stamp out foot-and-mouth disease in these islands. It would indeed be absurd to do so, because it is obvious that, if it is possible to keep our country free from the disease by slaughtering a reasonable proportion of its live stock, the policy adopted is to the fullest extent justified. A proportion of the live stock must in any case perish, whether by destruction or the ravages of the disease, and a clean bill of health is essential to the maintenance of our export cattle trade.

The only question that arises—and it is a very serious question—is whether it will, in fact, be possible in the future, by the present means, to maintain a clean bill of health in the matter of foot-and-mouth disease. Territorial protection from infection of a specific sort, secured to animal life over a long period of time, in many instances renders the potential subjects of infection highly susceptible. A suitable example is the havoc wrought by influenza when, at rare intervals, it is introduced to remote Pacific islands.

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In this connection it is interesting to observe that the susceptibility to some diseases does not apparently, in ordinary circumstances, increase by this form of protection; smallpox may be given as an example. The reason for this may be that one disease may give immunity from another. There is little doubt that the common winter "colds" of Northern Europe give some degree of immunity from pneumonia. On the South African Tableland, where common colds are rare, pneumonia and strangles, where they occur, are unexpectedly serious and fatal.

May it not be that the well-observed resistance to pneumonia of seasoned working horses in cities, as compared with horses brought into cities from grass, is due in part to the colds which from time to time the former suffer during the winter?

Foot-and-mouth disease in its nature is unique: there is no common disease at all like it, consequently there is no opportunity of immunity being given in the ordinary course of events. If, therefore, the susceptibility to foot-and-mouth disease is increased by territorial protection—and the experiences of countries where the disease is endemic suggest that the susceptibility is so increased—then the ever-growing communications between these islands and the European Continent, on the one hand, and an ever-increasing susceptibility among our live stock on the other hand, may ultimately combine to defeat entirely all our defensive efforts.

The English Channel may, and probably will, prove too slender a barrier, when the peoples of the Continental countries and our own people (some of them possibly carriers of infection) pass to and fro across it on the water, in the air, and, it may be, under the water, always increasing in numbers until, so far as communications are concerned, the populations are more intermingled than at one time were the tribes on either side of the Thames.

It may, without stretch of the imagination therefore, be suggested that the time is not far distant when, unless foot-and-mouth disease is stamped out on the Continent of Europe, it will become endemic in the British Isles.

Internationalism, which is at present the political ideal of many, is not capable of being limited to policy and morals.

Nationalism, which is merely the principle of tribal "tabu" practised on a great scale, had, and yet may have, a solid scientific foundation in the protection of human and animal life from the epidemic diseases which were thus kept without the natural barriers of sea-girt countries, and even without the arbitrary frontiers of Continental races.

Clearly, therefore, the problem of the future protection of our

live stock is a task for the bacteriologist rather than the sanitary administrator. It will not be the butcher, but the combined efforts of the biological scientists of the Continent and this country working together which will ultimately solve the difficulty.

The moral is a simple one: subsidise research. Let the nation cast its bread upon the waters, and retrieve it after many days in the form of healthy beef.

AILMENTS WHICH SIMULATE FOOT-AND-MOUTH DISEASE.

By Captain JOHN FOX, M.C., M.R.C.V.S.,
Veterinary Inspector of the Ministry of Agriculture.

The following are worth placing on record, as they are ailments which simulate, and have actually been reported on, foot-and-mouth disease:—

Ulceration of Buccal Cavity due to Teething.

(1) *Pigs.*—Was shown four dead pigs about a fortnight old. All showed ulceration of the mucous membrane of the premaxilla, the ulceration apparently being due to irregularities of the incisors of lower jaw. The remaining stock on premises, two sows and six unweaned pigs, were healthy. These pigs were within 300 yards of a foot-and-mouth affected place, which made the lesions appear more suspicious than under ordinary circumstances.

(2) *Sheep.*—Several sheep lame and on their knees. Examination showed no mouth lesions; but between the digits a lesion often affecting all four feet simulating a ruptured vesicle. The cause of the trouble is very often obvious on examination, when one discovers a mass of soil and herbage tightly wedged between the digits. This condition is often seen and is practically confined to sheep penned on roots, especially after frosty weather. The lesion is of the nature of a blister caused by the friction of the hardened material embedded between the digits, the superficial layers of the skin are rubbed off, leaving a weeping wound, which heals readily after removal of the cause. The condition appears suddenly, and affects numbers of sheep simultaneously. A similar condition is sometimes seen in cattle, and may be the commencement of foul in the feet.

(3) Chewing the Cud in Sheep.

Sheep on roots suddenly show marked salivation, accompanied by loss of appetite and symptoms of indigestion. These symptoms may become rapidly exaggerated, the animal becoming comatose and dying within a period of twenty-four to forty-eight hours of the outset of symptoms. On examining the living animal no lesions are found in the mouth or on feet; the sheep are tympanitic and the

pupils dilated. I have not had the time or opportunity to make a post-mortem.

The disease usually appears where sheep are folded on roots which have been partly eaten and exposed to the weather, and would appear to be a form of toxæmia.

FOOT-AND-MOUTH DISEASE.

By G. MAYALL, M.R.C.V.S.,
Bolton.

FOOT-AND-MOUTH disease has been known in Europe since the seventeenth century and in England since 1839. Its prevalence is world-wide, and the fight against it has occupied the time and energy of many of the best brains of various countries, yet its spread and ravages still cause huge losses, and there is much about it of an elementary nature that does not seem to be known. Can the spread of the disease be limited by strict sanitary measures and disinfection? There is some evidence that this is impossible. In Switzerland sanitary measures are carried out which would hardly be tolerated in this country, and yet infection spreads. When the disease is declared on a farm it is fenced or wired in. The milk must not leave the place, the children must not attend school, and workers lodging on the holding must not go to work. Urgent field work is carried out by neighbours, and these neighbours also re-victual the farm. The whole place is held up in a state of siege. Nobody who has attended the sick cattle is allowed to leave the place on any pretext whatever; feathered stock, cats and rabbits are killed; disinfection of the sheds and cattle is carried out by trained men under the supervision and direction of veterinary surgeons. If it was possible to prevent the spread of aphthous fever by sanitary measures, it can hardly be doubted that the Swiss would have succeeded in the struggle. Yet in spite of all this energy, and although Swiss conditions are favourable for sanitation, yet the state of the country as regards foot-and-mouth disease is no better than that of the countries which surround it. Is not the reason for this that certain animals act as carriers? Subjects that have had the disease once contain the virus in a latent form in their internal organs for a long time, and in this condition pass out infection on their surroundings or neighbours. At the time when cattle are brought in and richly fed, getting insufficient exercise and in many cases breathing bad air, the disease seems to awaken to a new lease of life. Through these three factors digestive disturbances arise and toxins form which may materially help the action of the virus.

One little matter that needs clearing up more plainly is whether

the disease is purely one of domestication. About half a dozen text-books I have referred to state that the malady may be contracted by all cloven-footed animals. One French book qualifies this by stating that "wild herbivora are apt to infection." Curiously enough the general statements about all cloven-footed animals being liable to infection are not supported in any instance by an account or description, either authentic or otherwise, of a case of the disease in any wild animal. A reliable observer, H. Lenthold, Gams (St. Gallen) says that in the carrying out of many years' duties in connection with aphthous fever he has never seen a case of the disease in deer or chamois that have been in intimate contact with cattle suffering from foot-and-mouth disease. Is there any record of a guinea-pig being naturally infected with foot-and-mouth disease? If the disease is limited to domestic cloven-footed animals, one point in its investigation may have been gained.

THE PRESENT PROBLEM OF FOOT-AND-MOUTH DISEASE IN ENGLAND.

By J. A. ARKWRIGHT, M.D. Camb., F.R.C.P. Lond.
*From the Lister Institute, Chelsea.**

That the problem of foot-and-mouth disease is not one that is likely to be easily or quickly solved is evident from the large amount of careful experimental work which has been already done on the subject during the last twenty-five years. In 1898 Loeffler and Frosch began their long series of observations which have been carried on by them and their successors almost continuously since, on the nature of the virus and methods of producing immunity artificially in domestic animals. A great many valuable observations and experiments have also been made in France by Nocard, Vallée, Carré and others, as well as in Italy, Holland and elsewhere. The result of all this work has been that a platform of sure knowledge has been reached, but it cannot be denied that much information is still needed to complete the knowledge of the natural history of the disease, the nature of the virus, and still more to enable proper methods of repulse and attack in the face of epidemics to be devised.

Whilst briefly recapitulating the basal facts which have been ascertained, it may be useful to indicate at the same time the chief gaps in present knowledge. The virus can be obtained free from recognisable bacteria or other microbes in a clear watery filtrate after passing it through a porcelain filter, and the original blister fluid may be so potent that when diluted 100,000 times one cubic

* By permission of the Editor of the *Lancet*, February 2, 1924.

centimetre is sufficient to infect a susceptible animal. The blood also is infective early in the disease. The virus as examined in the laboratory is rendered inert by a temperature of 60° C. (for five to ten minutes), but weak disinfectants—e.g. 1 per cent. carbolic—do not necessarily destroy it. Uncontaminated virus will keep and remain active in the ice-box for months. The disease can be communicated by scarification, subcutaneous or intravenous injection, or by feeding. Exposure to light or drying has usually rendered innocuous material which has been deliberately contaminated.

Against this positive knowledge must be set the extreme variability in activity of the virus, the tendency for it to die out during experimental passage, and, on the other hand, the high degree of infectivity of the spontaneous disease and the readiness with which inanimate objects and contaminated ground appear to be implicated in the natural transmission of the disease. There are no accepted experimental data showing how long and under what conditions straw, litter and fodder, or byres and stalls can retain infection.

No microscopically recognisable organism has at present any plausible claim to acceptance as the cause.

Infectivity of Cases of Disease—Susceptibility of Different Animals.

As regards the infectivity of living animals suffering from "foot-and-mouth" it is known that, as a rule, the disease can be easily transmitted by wiping the mouth or lips of a susceptible animal with material from a case of disease. It has also been shown by Loeffler that an animal is occasionally capable of passing on the disease to its neighbours in a cowshed after apparent recovery for as long as seven months from the onset of illness. It is believed that the virus may be imprisoned in the horn of the hoof and subsequently be set free in an active condition four months after the attack by the wearing away of the hoof. On the other hand, Vallée has shown reason to think that the period of infectivity during the acute stage is rather brief, but that it begins during the incubation period.

Concerning the susceptibility and liability to carry infection of man and animals in the farmyard, other than cattle, sheep and pigs, very little has been definitely settled, though Hooker claimed that nearly all such animals, including rats, dogs, rabbits and fowls, could be infected, and the disease transmitted from them to ungulates. Loeffler, without recording many experiments, admitted the possibility of all animals and birds, especially starlings, carrying the infection passively, but he failed to infect rodents and birds, etc.

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Immunity.

A great deal has been learnt about the production of active and passive immunity. Though protective serum from horses, oxen or pigs can be obtained, it is either inapplicable for other reasons or too expensive for general use. Active immunisation by direct infection, "*aphtisation*," is uncertain in its results on account of the difficulty of regulating the severity of the attack or foretelling the duration of protection. Temporary passive immunisation by the injection of the serum of recovered animals may be of great use in the presence of an extending epidemic, especially in connection with active immunity produced by inoculation immediately with virus from a previous case. The blood of animals taken during an attack has been advocated by French workers as a means of producing an immunising general illness of short duration without local lesions. The great bar to the utility of these various methods is the short duration of immunity even after an attack of disease, when a second attack may occur in so short a time as six months or even sooner. It has also been found by Vallée that one strain of the disease does not always protect against another strain of virus even for a few weeks. Prophylaxis, raising the natural immunity by inoculation of foreign protein, has been advocated as an expedient with a view to modifying the severity of an attack.

Animals Suitable for Laboratory Research.

Closely connected with the question of the susceptibility of rodents, etc., is the choice of animals for research. Loeffler and his colleagues gave no support to the view that rabbits and guinea-pigs could be used as laboratory animals, but in 1921 Waldmann and Pape found that guinea-pigs could be infected with considerable regularity if the inoculation were made on the hairless skin of the metatarsus, and that by this means vesicles could be produced there and in the mouth. This discovery was confirmed by Hobmaier, Uhlenhuth and others, and great hopes were raised that by the easier and cheaper methods of research thus opened up knowledge would be advanced more quickly. The new technique does not, however, appear to have given much advantage so far, though the virus can be kept active by passage through a series of guinea-pigs and remain still infective for large animals. The amount of virus obtainable in this way is not enough for the hyper-immunisation of large animals, and no definite attenuation has been associated with passage in these rodents at all comparable to that in the case of smallpox and vaccinia. Nevertheless, the fact that rodents are susceptible, despite previous failures to infect them, is an important piece of knowledge.

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Work in Great Britain.

Turning to work which has been done in this country, the opportunities have been very limited. In the first place "foot-and-mouth" has been a rare disease here in comparison with the state of things prevailing on the Continent of Europe, owing to the adoption of the policy of slaughter which has had considerable success, though less effective recently. The result of this draconic measure has been to make serious clinical observation in the field of the disease, its progress, infectivity, and means of spread very limited and experimental study impossible.

When in 1921 the Ministry of Agriculture decided to inaugurate research on foot-and-mouth disease, it was with the especial hope that it would be possible to cultivate the virus and work out a method of immunising animal prophylactically. It was considered necessary that the work should be done entirely on board ship, and a disused mine-sweeper and a lighter for animals were fitted up for the purpose. It was not till after the research was over that the method of working with guinea-pigs was published, but in any case experiments with calves, sheep or pigs were then, as now, an essential to the work. It was necessary not only to maintain a stock of virus, but to make experimental inoculations with very limited accommodation.

Experience soon showed that operations could proceed only very slowly, and must be seriously limited in their scope and often brought to a standstill by want of demonstrably active virus. The laboratory was open for work for seven months, from the end of November 1920 to July 1921, but for most of that time an active virus was not available. It was found necessary about the latter date to close down the research as the result of the urgent demands for general economy in Government departments together with the impossibility of holding out the prospect of much gain to knowledge in the immediate future under the exisiting circumstances. This aspect of the venture has been explained by Professor Robert Muir in a letter to *The Times* of January 14th, who at the same time points out that future research is needed, but must be carried out on land, of course, with careful arrangements for isolation.

As a brief summary of the kind of research which is urgently needed the following lines of investigation may be suggested.

1. Further study of the purified as well as of the natural virus, especially with regard to its resistance to drying and daylight, and its culture.

2. Search for some reliable laboratory method of diagnosis, especially for the recognition of slight cases of disease, whether by inoculation of small animals or by some immunological test.

3. The investigation of the natural means of spread with regard to (*a*) the period of illness which animals are most infective and how long infectivity remains; (*b*) the persistence of the contagion on inanimate objects; (*c*) whether other animals than ungulates—e.g. rodents and birds—become infected naturally or act as passive porters of the virus, and in either case whether they are efficient as agents for the transmission of infection to farm stock.

THE PRACTICAL ISSUE.

It is to be hoped that Great Britain will soon again be free from infection, and then it will be seen whether the country, the Ministry, and the farmers will have the faith and courage to set up and maintain a proper experimental station on land in a place which can be sufficiently isolated. An easier, if less enterprising and more ignoble, path would be to leave the investigation to our enthusiastic French, Dutch and German fellow-sufferers.

There is a further consideration which should stimulate this country to take seriously the need for investigation of the whole subject here. The problem in this country is not quite the same as abroad. There, where the disease is always present with constantly recurring epidemics, the main flow of energy and hopeful enterprise has been towards devising schemes for prophylaxis by vaccination or serum, and for treatment and cure. But here the main problems are, have been, and will again be, prevention of invasion and avoidance of spread. For these objects an efficient vaccine or serum or both would be an invaluable addition to the armamentarium and might cut short an epidemic when it had started. There may, however, be other means to the desired end more suited to the protection of our insular position. To this end careful study should be devoted to all obscure points in the natural history of the disease, and an investigation into the question of the occurrence of the disease in every likely or possibly implicated animal should be thoroughly undertaken, in addition to inquiries into other possible means of transmission.

FOOT-AND-MOUTH DISEASE IN RATS.

BY J. M. BEATTIE, M.A. (N.Z.), M.D. (EDIN.),*
Professor of Bacteriology, University of Liverpool;
AND
DAVID PEDEN.
(*From the Bacteriological Department, University of Liverpool.*)

ABOUT the middle of December last a number of glands, mainly pre-scapular, from cows were brought to the laboratory for examination. They had been collected by the chief city meat inspector, who

* By permission of the Editor of the *Lancet*, February 2, 1924.

considered them abnormal, and following his routine practice he sent them for examination and report. The glands were enlarged, some of them inflamed, the pulp being soft and œdematous, while others showed irregular and more or less extensive hæmorrhages. Scrapings from the glands were made, but no special changes, other than those observed with the naked eye, were present. Neither bacteria nor protozoa were found. Cultures gave growths of a short-chained streptococcus which, at first, was best developed under anaerobic conditions; later, this organism grew quite actively as an aerobe. We did not attach much importance to this organism as no special precautions had been taken in collecting the glands. A further series of glands, received at a later date, showed exactly the same conditions.

All the glands had been taken from carcasses of cows slaughtered because they had been in contact with cases of foot-and-mouth disease. None of the animals showed any of the usual signs of this disease, and they had been sent to the abattoir as non-infected. The fact that these cows were from an infected farm or dairy added special interest to the examination, and we carried out a series of experiments which have led us to believe that some of these glands contained the virus of foot-and-mouth disease, and that the disease could be produced in some laboratory animals. The work is still incomplete, but the results so far obtained and confirmed are, we think, of sufficient importance to justify publication.

Description of Experiment.

On December 18, 1923, a rat (*a*), a mouse (*a*), and a rabbit received a subcutaneous inoculation of a saline emulsion of the glands, and a mouse (*b*), a rat (*b*), and a guinea-pig were fed on the minced glands. They received one feed only, but the guinea-pig was also given a subcutaneous inoculation.

On January 1, 1924, the guinea-pig died. There was no evidence of any lesions in the feet or in the mouth, but all the glands in the regions of the jaws were enlarged and contained a semi-solid yellowish purulent material. There was marked injection of the intestines, and some serous fluid in the peritoneal cavity. This fluid was crowded with inflammatory cells, mainly of the mononucleated type. Cultures from this fluid and from the glands yielded a short-chained streptococcus, and a small Gram-negative coccus. Both these organisms were pathogenic to rats and guinea-pigs; the Gram-negative coccus produced very marked gelatinous œdema at the site of inoculation, but we have no evidence, at present, to show that these organisms had any causal connection with the disease. The rabbit

showed no sign of infection and is still alive ; mouse (*a*) died of streptococcal septicæmia.

On the 4th, rat (*a*), which had received the subcutaneous inoculation, died. There was well-marked œdematous swelling on the dorsum of both hind feet. The tail had been completely bitten off at the root. No special lesion was noted in the mouth, and, unfortunately, the lungs, which in the later animals showed important lesions, were not examined. A rat (*c*) was vaccinated on the dorsum of one of the left hind feet with the clear serum from the swollen foot of rat (*a*) ; only a very minute drop of the serum was used.

On the 10th, rat (*b*), which had been fed on the cow glands, was killed. It had shown for one week marked œdema of the dorsum of both its hind feet (the right foot was held off the ground on the day on which the animal was killed). The œdematous condition was exactly similar to that observed in rat (*a*), but, in addition, there was a very distinct small vesicle with clear fluid in the dorsum of the tongue, and on the anterior under surface a definite small ulcer. The tail was very much swollen, and about half of it had been bitten off. Both lungs showed infarct-like areas of gelatinous œdema with, here and there, distinct vesicle formation on the pleural surface.

On the 12th, a rat (*i*) was fed on a second series of cow glands, and a rat (*j*) was inoculated with an emulsion from the same series of glands.

On the 16th, rat (*c*), vaccinated on the 4th, was killed. This rat had been ill for several days after the vaccination, and there was definite swelling of the vaccinated foot. This evidently was due to the irritation, and subsided in a few days ; but the swelling returned and the dorsum of the opposite foot became swollen. The rat in its general condition was much improved, and would probably have made a complete recovery. On examination, besides the œdema noted, two small scars, very suggestive of ruptured and dried-up vesicles, were seen one on the under surface and the other between the toes of the right hind foot. There were two small unruptured vesicles on the dorsum of the tongue near the root, and in the lungs there were numerous irregular areas of gelatinous œdema.

On the 17th, rat (*i*), fed on January 12th, was examined under an anæsthetic. The feet were red and inflamed, and there were three distinct vesicles, two of them hæmorrhagic, on the under surface of the toes of the left foot. Rat (*j*) showed distinct œdematous swelling of the dorsum of both feet.

On the 19th, mouse (*b*), fed on December 18th, died. This mouse had been ill, but appeared to have recovered completely, with the exception of the tail which remained considerably thickened. On

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examination no lesions were found in the feet or tongue, but two gelatinous œdematous areas, similar to those seen in the rats, were present in the lungs.

On the 21st, rat (*i*), fed on the 12th, was killed. There was very marked œdema of both hind feet, especially the right foot. This was more marked than in any of the previous animals. There were definite vesicles on the under surface of both hind feet and between the toes. The tongues showed two minute vesicles, one on the lateral aspect and one on the dorsum near the root. Both lungs showed a very large number of the areas of gelatinous œdema noted in the other rats. Rat (*j*), inoculated on the 12th, was also killed; it showed, besides the œdematous swelling of the feet, several very well-marked vesicles on the under surface of both the hind and fore feet. There was no lesion in the mouth, but the œdematous patches were present in the lungs.

Summary.—Four rats which have been fed on, or inoculated with, cow glands have developed œdematous swelling of both hind feet, two have shown, in addition, clear vesicles on the under surface of the feet or between the toes, two had vesicles on the tongue, three, and one mouse, had vesicles or patches of gelatinous œdema in the lungs (the lungs of the fourth were not examined). One rat was vaccinated with a very small drop of the œdematous fluid from the foot of an infected rat, and this animal also developed the œdema of the feet, the vesicles on the under surface of the toes, vesicles in the tongue, and the gelatinous œdema in the lungs.

Discussion.

Since making these observations we have examined eighty healthy rats, and no trace of similar lesions in the feet, mouth, or lungs were found, and in a very large experience with rats no similar condition has been seen by us. The special localisation of the lesions in the feet and the tongue are similar to those found in foot-and-mouth disease; the special and unique condition in the lung has, so far as we know, never been described. The results were obtained with specially inflamed glands from cows which had been contacts with foot-and-mouth disease. With such glands no rat has failed to produce the condition.

If the condition we have produced in these rats is foot-and-mouth disease, and we see no reason to doubt this, and if the experiments are confirmed, a very important avenue for investigation has been opened up, for the following reasons:—

1. The carriage of the disease from place to place either by the infected rat itself (and we know that rats migrate over considerable

distances), or by the foodstuffs in which the rats live and die, is, at any rate partially, if not wholly, explained.

2. The vesicular condition on which diagnosis at present depends may merely be a manifestation of some deeper infection—just as herpes may be an outward sequel of a pneumonia, and that the distribution for food of the flesh of contact animals may be a source of spread of the disease.

3. If the disease can regularly be produced in rats, the great difficulty of experimental investigation and the supposed risks are considerably reduced. Rats can be very easily isolated, and work in relation to the cultivation of the virus can be carried out with very little difficulty, and, in our opinion, without the slightest danger.

Our great regret is that we have not been able to experiment with material from animals known to be suffering from the disease. We have asked for it, but have been told that the risk is too great, and we therefore publish these experiments in the hope that we, or others, who are working at the subject may be given reasonable facilities to carry out a thorough investigation into a disease which has cost so much to the nation.

NOTE.—Another rat which received one feed of blood from rat (*b*) on January 10th, now (January 22nd) shows very typical swelling of the dorsum of both hind feet, two small vesicles on the tongue, and one very typical vesicle full of gelatinous fluid on the pleural surface of the right lung.

EXPLANATION OF THE OUTBREAK IN ABERDEENSHIRE. EXONERATION OF IRELAND.*

THE circumstances of the outbreak in Aberdeenshire have been so much in dispute in that county and in the rest of Scotland that the Ministry desires to give publicity to the following letter which was, on the 20th of January, addressed to the Clerk of the County Council at Aberdeen, setting out the facts as the Ministry knows them :—

FOOT-AND-MOUTH DISEASE.

SIR,

I am directed to refer to your letter of the 24th ultimo addressed to the Ministry, and also to your letter of the same date addressed to Major Mackenzie Wood, M.P., of which a copy has been furnished to the Ministry, urging that a public inquiry should be held as to the circumstances attaching to the outbreaks of foot-and-mouth disease in Aberdeenshire.

* Abstracted from the Weekly Report of the Ministry of Agriculture and Fisheries, February 7, 1924. See also reference in the Editorial on p. 96.

As regards the original outbreak at Towie Barclay, confirmed on the 18th of November, the Ministry gathers that there exists a suspicion in the minds of the Local Authority that the disease was spread to the county by Irish stock. This matter has been carefully investigated by the Ministry, and the conclusions arrived at were detailed in the Ministry's letter to you dated the 20th of December. To recapitulate the contents of that letter, it may be stated that disease at Towie Barclay appeared amongst the sixteen Irish store cattle on the premises. These were from a lot of seventeen which left Ballyshannon on the 22nd of October and arrived at Hope Farm, Bucksburn, Aberdeen, on the 24th of October. The seventeen cattle remained at Hope Farm until the 31st of October, when they were exposed for sale at Messrs. Reith and Anderson's Mart, Kittybrewster, Aberdeen, where sixteen of them were sold to Mr. McIntyre of Towie Barclay. The seventeenth animal remained at Messrs. Reith and Anderson's Mart, and was still healthy when examined on the 21st of November. All the other stock which were at Hope Farm with these sixteen Irish cattle, and also all the stock sold at Messrs. Reith and Anderson's Mart on the 31st of October, were traced and found healthy.

These facts point to the definite conclusion that the sixteen Irish cattle were healthy on the 31st of October, nine days after leaving Ireland, and that they must have contracted infection after arrival in Great Britain.

Your letter further states that certain circumstances have led to the suspicion that the disease was taken to the other farms on which outbreaks have occurred by the Ministry's Inspectors. The following facts, which are communicated for the information of your Local Authority, lend no support whatever to this view.

(1) According to the reports furnished to the Ministry, its Inspector, Mr. J. Bishop, arrived at Aberdeen on the evening of the 17th of November last and proceeded on the following morning, accompanied by the Chief Constable of Aberdeenshire, to the premises of Mr. McIntyre at Towie Barclay, where he confirmed the existence of foot-and-mouth disease. Before entering the premises Mr. Bishop disinfected his overall clothing. Before leaving the premises he again disinfected his clothing and returned with the Chief Constable to Turriff.

On the afternoon of the 18th of November he received a message from the Police that the existence of foot-and-mouth disease was suspected on the premises of Mr. James Forbes, at Gerrieswells, Drumblade. Again accompanied by the Chief Constable, Mr. Bishop thereupon proceeded to that farm at once, and on arrival thereat

disinfected his clothing. At the time of his arrival the disease was suspected to exist amongst a lot of twelve Irish heifers which had been purchased on the 31st of October at the same Mart in Aberdeen as the Irish cattle first affected on the premises of Mr. McIntyre. By the time Mr. Bishop arrived two of the twelve heifers had died, and a third died whilst Mr. Bishop was on the premises. He examined the three dead animals and then proceeded to examine the mouths and feet of the others. On completion of his examination he informed the farmer that in his opinion foot-and-mouth disease did not exist. The owner was satisfied as to this, and then asked Mr. Bishop merely to look at some cattle of his own rearing in other byres. Mr. Bishop thereupon looked into two byres and saw the cattle in question, but did not handle any of them. He then disinfected his clothing and boots and returned to Turriff.

On the 28th of November the existence of foot-and-mouth disease at Gerrieswells was again suspected and reported to the Police by Mr. Forbes. Mr. Bishop again visited, and found foot-and-mouth disease to exist in one home-bred animal in a byre on the other side of the building from where the Irish heifers were housed. The lot of Irish heifers amongst which disease was suspected on the 18th of November were at this time healthy, and when they were slaughtered two days later they were still found to be free from foot-and-mouth disease.

With these facts in mind there would appear to be no evidence to support the contention that the Ministry's Inspector conveyed the disease from Towie Barclay to Gerrieswells. In fact there is, in the opinion of the Ministry, far more evidence against such a possibility, inasmuch as if Mr. Bishop had not been properly disinfected when visiting these premises on the 18th of November he would almost certainly have infected the animals which he handled on that occasion. It appears to the Ministry to be quite illogical to suggest that Mr. Bishop conveyed disease to animals which he merely looked at whilst those which he actually handled were still free from foot-and-mouth disease after a lapse of twelve days from the date on which they were handled by him.

It may also be remarked that disease has appeared in the Gamrie district of Banffshire—which is approximately the same distance from the Towie Barclay outbreak as is that at Gerrieswells, and that no Veterinary Inspector of the Ministry had visited the Gamrie farm before the existence of disease was actually confirmed, nor has it been possible up to the present to assign an apparent origin for the appearance of disease there.

(2) As regards the outbreak at Ordiey, Auchterless, confirmed on

the 8th of December, which farm is in the adjacent parish to Towie Barclay, and about one mile distant therefrom, the Ministry notes that the Local Authority take the view that disease may have been conveyed to this farm by the Ministry's Inspector who visited Ordley Farm on the 1st of December and took the temperatures of several cattle on the premises. It will be relevant, therefore, to state the history of this Inspector's movements.

The Inspector who visited Ordley Farm on the 1st of December arrived at Turriff on the 19th of November for employment in connection with foot-and-mouth disease. Between the 19th of November and the 5th of January he was never on any premises infected with foot-and-mouth disease, nor did he visit any premises on which disease was suspected, other than Ordley Farm. Further, he was on patrol duty visiting farms in the neighbourhood of Towie Barclay and taking temperatures daily both before and after the 1st of December, the date on which he is suspected of having conveyed the disease to Ordley. No outbreak of foot-and-mouth disease has occurred on any other premises visited by him. Moreover, the Ministry is assured that in the course of the whole of his patrol duties he took the utmost care in the way of personal disinfection (including the disinfection of his thermometer before and after use) before entering and on leaving the farms. With these facts in view, the Ministry is quite unable to accept the statement that this Inspector was responsible for carrying the disease to Ordley.

It is stated in your letter of the 24th of December that Mr. and Mrs. Hutcheon, of Ordley, visited Towie Barclay House on the 29th of November, which was also the Ministry's information. The Ministry has no information as to whether any precautions were taken by them in the way of personal disinfection to prevent the risk of their carrying infection back to Ordley Farm, and, in the absence of definite information on the point, the Ministry must assume that no such precautions were taken. If this is the case it would appear to the Ministry far more likely that infection was taken to Ordley in this manner, although Mr. and Mrs. Hutcheon may not have visited the byres at Ordley on their return from Towie Barclay.

It should, however, be remembered that disease existed for at least a week or more on the premises of Mr. McIntyre at Towie Barclay before its existence was reported, and that even after the Ministry had confirmed the existence of disease on these premises steps were not taken by the Local Authority to furnish continuous Police supervision of the infected premises. Although the Ministry's Inspector pointed out to the Chief Constable the necessity for such supervision the latter still refused to supply this, and it became necessary for

the Inspector to make special representations to the Local County Clerk urging the desirability of taking steps to arrange for a Police Officer to be stationed on the infected premises before such supervision was actually furnished.

In view of the above facts, the Ministry sees no sufficient reason which would justify the institution of a special public inquiry into the circumstances attaching to these outbreaks.

As, however, some criticism of the Department has been made public in connection with this matter, the Ministry thinks it desirable that all the ascertained facts relating to the outbreak should be made known. The views of the Local Authority to which publicity has been given do not disclose all the available evidence, and the Ministry proposes therefore to publish this letter in the Press.

I am, Sir,

Your obedient Servant,

(Sgd.) A. D. HALL.

The Clerk to the C.C.,
County Buildings,
Aberdeen.

MEASURES TAKEN AGAINST FOOT-AND-MOUTH DISEASE IN SWITZERLAND DURING THE LAST FEW YEARS.*

BY M. L. PANISSET,

Professor at the Alfort Veterinary School.

SWITZERLAND has been and still is greatly troubled by foot-and-mouth disease. It is the thoroughfare for the great Continental countries of Western Europe, and the great danger from exposure to contagion has caused it to institute rigorous preventive measures against its neighbours. Regions still indemnify themselves from the disease by imposing quarantines that last for months. Measures against the disease have been carried out by Government officials, veterinary surgeons, owners, inspectors and others. The repressive work may be classed under three heads :—

1. General Slaughter.
2. Sanitary Measures.
3. Treatment with the Blood of Cured Animals.

1. In August 1914 the Federal Government, in view of the great traffic in men and animals due to mobilisation, promulgated a law providing for the slaughter of all animals affected with foot-and-mouth

* *Revue Générale de Médecine Vétérinaire.*

disease, and also all contaminated animals. Slaughter was largely practised, but the order allowed for the consideration of particular cases, according to the views of the inhabitants, the disposition of the locale, and the chances of contagion. From the month of August 1914, 1,058 head of cattle and 683 head of small animals were slaughtered. Six months' experience was not sufficient to judge of the value of the experience, but it soon showed that eradication was not to be rapidly realised by slaughter. In the following years slaughter was indulged in in cantons hitherto free, where infection had infiltrated, and in isolated foci which appeared here and there far from centres of contagion. In 1915 to 1918 inclusive, 6,446 large and 3,459 small animals were slaughtered. Up to June 1919 it was thought that slaughter associated with other sanitary measures had confined the malady to western Switzerland, but in June 1919 the disease flamed up with great gravity and became very virulent, and all precautionary measures were shown to be insufficient. Although the slaughter law remained in force, it was applied with circumspection, and at present, as a method, it has almost ceased, being confined almost exclusively to the canton of Geneva. Slaughter is an onerous occupation, but rational disposal of the cadaver and offals can diminish its costliness. Meat from slaughtered animals has been sold at about half the usual price ; a large part has been sold directly to the people in the communal establishments of the slaughter houses. Owing to a system of compulsory insurance and without the premium per head exceeding 2 francs 50 centimes in the cantons most affected, slaughter has not been a heavy charge on the Budget. The indemnity provided was 70 per cent. of the value of the animal, but it is now in the region of 90 per cent. This indemnity is paid as regards half from the cantonal coffers and half by the Federal Budget. The part paid by the State from 1915 to 1919 inclusive has amounted to 4,118,596 francs. Slaughter was accepted well by the people concerned except in Tessin, where the hostile attitude of the inhabitants obliged the authorities to discontinue it.

In areas of infection, feathered farm stock, cats and rabbits were killed ; dogs were chained up. These operations have shown that *slaughter is a good measure at the commencement of an epidemic when only isolated foci exist ; it is perhaps also an excellent measure at the end of an epizoötic to free the country from foci which seem to have become centres of endemicity with all its dangers.* In the case of invasion by the malady, the moment arrives when slaughter becomes useless. A centralised organisation appears indispensable for its success. Slaughter in regulated and supervised centres renders the economic disposal of slaughtered animals quite feasible.

2. *Sanitary Measures* are carried out carefully, thoroughly and devotedly by the Swiss. Outbreaks are immediately notified by telegram to the official veterinary surgeon ; immediately the cantonal veterinary surgeon orders " enforced sequestration." The authorities carry out the prescribed measures ; animals *and persons* are shut up on the holdings ; the steading is surrounded by wooden bars and barbed wire ; the milk may perhaps only be used on the place ; children must not go to school, nor workers living on the holding go to factories or workshops. The work of the farm is carried on by neighbours, who also revictual the confined place. After a first disinfection these restrictions are relaxed. Cured animals are supervised for *eight months*. After cure the claws of the animals are carefully cleaned, disinfected and pared, painted with tincture of iodine, and covered with a thick layer of Stockholm tar. Gendarmes see that the prescribed measures are strictly observed. Disinfection is carried out at intervals of two or three weeks. The inspector of cattle is of the greatest value in the fight against the disease. He knows the owners, the animals and the locale. The veterinary organisation is good ; veterinary surgeons are plentiful ; cantonal veterinary surgeons exercise authority on each few square miles of territory. In spite of all this, results show that the sanitary state of Switzerland is no better than that of the countries which surround it. Sanitary measures are effective in the first foci ; they circumscribe it, but as the foci multiply there is no sanitary barrier solid enough to oppose the extension of the plague or to stay its penetration into disease-free zones.

3. *Treatment by the Blood of Cured Animals.*—This procedure consists essentially in the principle of collecting blood from cured animals, that is to say from those in which the malady has appeared three or four weeks previously. This blood is injected into all the animals of the holding as soon as a case of the malady arises. Throughout the whole of Switzerland this treatment is applied freely and without control by veterinary surgeons. These practitioners seek out cured animals, collect the blood, defibrinate it by beating to hinder its coagulation and allow of it to be inoculated. Doses vary with different veterinarians, regard being paid to injection of effective doses and the difficulty of obtaining all the desirable blood. In many places veterinarians devote the whole of their time to this work. The injection is no good as a curative, but is quite effective in limiting an attack to a benign form. Numerous animals thus treated were hardly ill at all ; the eruptions were discrete, without complication. Pigs benefit largely from the treatment. The doses as a rule are 300 to 500 cubic centimetres for cows, 800 for bullocks, 200 to 400 for heifers,

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20 to 30 for porkers, and 200 for adult pigs. The organisation at Lucerne sacrifices five or six animals a day, and prepares 60 to 80 litres of blood—a sufficient quantity to treat about 200 animals. The treatment by the blood of cured animals is a method which has a certain scientific basis. It is not preventive, but it seems capable of diminishing the gravity of the natural evolution of the malady.

Abstracts of Current Literature

Forgeot, M.—Foot-and-Mouth Disease.—Preservation of the Virus.—*Revue Vétérinaire*, January 1924.

Observations made at the laboratory on the small degree of contagiousness of the disease after rupture of the vesicles do not agree exactly with certain epidemiological peculiarities. The sequestration of the first herd affected at the beginning of epizoötics does not generally suffice to hinder the extension of the malady, and this is often due to the fact that freedom is permitted too soon. Precise and interesting observations show the possibility of preservation of the virus for a very long time. In an Alpine village the malady appeared and spread to all the farms at the beginning of winter ; the bad season caused total sequestration, which only ceased on the advent of spring ; at this time foot-and-mouth disease declared itself in all the animals of the neighbouring villages which had no relation in other respects with the rest of the country.

In another instance the malady was introduced into a herd by a young cow that had had aphthous fever six months previously. It must be admitted therefore, as the Swiss veterinary surgeons declare, that the virus may be preserved in the fissures of the claws ; perhaps even veritable reserves of virus arise on the deep surface of the hoof, virulent pockets form, gravitate downwards and open on the solar surface. Finally the appearance of foot-and-mouth disease in animals introduced into a shed that had been sequestrated three months seems to show that the virus can be preserved in non-fermentable material such as straw for quite this length of time.

Carré, H., and Vallée.—Contagiousness of Foot-and-Mouth Disease.—*Recueil de Médecine Vétérinaire*, September 1922.

At the commencement of an outbreak the urine of affected animals is virulent. In the saliva and dung the virulence disappears rapidly. Aphthous virus may be preserved six weeks to eight months in the fissures of the hoof or the lesions beneath the claws. These authors consider that affected animals should not be freed until fifteen days after their cure.

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